

# **SECTION-IV**

## **TECHNICAL SPECIFICATION OF MATERIALS**

### **FOR**

**Construction of 11KV Line (U/G Cable) and Service Connection for providing power supply for AIIMS , Balasore**

**TENDER NOTICE NO:- NESCO Utility / Const<sup>n</sup> of HT Line & SC / 26/20-21/ 3035  
Date: 24.03.21**

# TECHNICAL SPECIFICATION FOR CONSTRUCTION OF 11KV LINE (U/G CABLE) AND SERVICE CONNECTION FOR PROVIDING POWER SUPPLY TO AIIMS, BALASORE

## 1.0 NATURE OF WORK

The work covered by this Specification is for **construction of 11KV Line (U/G Cable) with installation all required materials/ equipments and Service Connection for providing power supply for AIIMS , Balasore** , shifting of existing network if any , testing , commissioning and dismantled the existing electrical network thereafter & returned the materials to NESCO Utility store under turnkey basis in deposit scheme.

### 1.1 SCOPE OF WORK

1	a) Supply & Laying of 11 KV 3 core 185 sqmm XLPE Cable with 200 mm dia HDPE pipe through HDD method (Avg.50 mtr/span along the road with one spare)- 0.62 Km (one spare)
	b) 11 KV Out Door VCB with Indoor CR Panel & 2 Core CT (CTR-600-300-150/1-1A, STC 25 KA/3 Sec.,class:0.5 & 5P10) without PT for transformer protection with differential protection – 1 no. including plinth.
	c) Construction of DP Structure- 3 nos.
	d) Shifting of 11KV Lines (Kuruda Feeder) 5 Span with one span guarding- 0.25 Km
2	Supply & erection of materials for Service Connection with all required materials- 0.08 Mtr.
3	Dismantling of existing 55 sq. mm. AAC - 0.3 km. , 9 mtr. RS Joist - 2 nos.,9mtr PSC Pole 300 Kg with all accessories - 3 Nos. etc. including transportation to NESCO store

**1.2 Item description with item wise materials required for the work to be supplied by the executing agency except Metering Cubicle , Metering Unit, HTTV meter & AMR Kit which will be provided by NESCO Utility.**

Sl no.	Item Particulars	Materials to be used
1	a) Supply & Laying of 11 KV 3 core 185 sqmm XLPE Cable with 200 mm dia HDPE pipe through HDD method) -0.62 Km (One spare)	3 Core 185mm <sup>2</sup> 11 KV XLPE Cable (From reputed manufacturer having type test certificate with spare cable)-1400 Mtr
		Heat shrinkable Jointing Kit for 3C x 185 mm <sup>2</sup> 11 KV XLPE Cable (Outdoor Type) - 16 Nos
	b) 11 KV Out Door VCB with Indoor CR Panel & 2 Core CT (CTR-600-300-150/1-1A, STC 25 KA/3 Sec.,class:0.5 & 5P10) without PT for transformer protection with differential protection.-1 no.	150X150mm 11mtr RS Joist (34.6 Kg/Meter) (SAIL/JINDAL/TATA make)(Avg Span 50 Mtrs) - 6 Nos for 3 DP
		100 x 50 x 6 mm M S Channel (each 2.8 Mtr. Long (9.2kg/mtr.) -78 Kg
		75 x 40 x 6 mm MS Channel (each 2.8 Mtr. Long (6.8kg/mtr.) - 115 Kg
		50 x 50 x 5 mm M S Angle (each 2.8 Mtr. Long 4.5kg/mtr.) with side angle- 95 Kg
	c) Construction of DP Structure -3 nos.	MS Bolt & Nut with Washer- 180 Kg
		No. 6 SWG GI Wire(Dia 4.8 mm)- 60 Kg
	d) Shifting of 11KV Lines (Kuruda Feeder) 5 Span with one span guarding – 0.25 Km	HDPE Pipe, 8", 10 Mtr.(Spec PE80-PN8,200MM dia)- 1400 Rmtr
		10 Core 2.5mm <sup>2</sup> Cu Control Cable( Un-armoured )- 50 Mtr
		16 mm M S Bolt & Nuts with Washer- 30 Kg
		18 mm GI HT Stay Set- 14 set
		7/10 (SWG) G.I. Stay wire (0.75kg/mtr appx)- 140 Kg
		11 kv Stay Insulator- 14 Nos
		HT Stay Clamp - 14 pair
		Concreting per Stay (0.5mtrx0.5mtrx0.5mtr=0.125cum - PCC 1:4:8)

		All. Cable Socket(185 sq mm) - 18 Nos
		40 mm dia GI Pipe Earthing Device.3mtr. Long - 10 Nos
		Earthing with Materials - 10 Nos
		11 KV Out Door VCB with Indoor CR Panel & 2 Core CT (CTR-600-300-150/1-1A, STC 25 KA/3 Sec.,class:0.5 & 5P10) without PT for transformer protection with differential protection- 1 No including plinth
		25x6 mm GI Flat(1.2Kg/mtr)- 120 Kg
		11 KV L.A. 12KV-10KA- 9 Nos
		Concreting of 11 Mtr RS Joist Pole (1.83 mtrx0.3mtrx0.3mtr=0.165 cum - PCC 1:3:6)
2	<b>Supply &amp; erection of materials for Service Connection – 0.08 Km</b>	3 Core 185mm <sup>2</sup> 11 KV XLPE Cable(From reputed manufacturer having type test certificate with spare cable)- 80 Mtr
		Heat shrinkable Jointing Kit for 3C x 185 mm <sup>2</sup> 11 KV XLPE Cable (Outdoor Type) - 8 Nos
		Heat shrinkable Jointing Kit for 3C x 185 mm <sup>2</sup> 11 KV XLPE Cable (Indoor Type) - 4 Nos
		150X150mm 11mtr RS Joist (34.6 Kg/Meter) (SAIL/JINDAL/TATA make) - 2 Nos
		100 x 50 x 6 mm M S Channel (each 2.8 Mtr. Long (9.2kg/mtr.) -100 Kg
		75 x 40 x 6 mm MS Channel (each 2.8 Mtr. Long (6.8kg/mtr.) - 80 Kg
		50 x 50 x 5 mm M S Angle (each 2.8 Mtr. Long 4.5kg/mtr.) with side angle- 60 Kg
		Material cost for Cable Trench with removable Cover- 20 Rmtr
		10 Core 2.5mm <sup>2</sup> Cu Control Cable( Un-armoured )- 72 Mtr
		16 mm M S Bolt & Nuts with Washer- 30 Kg
		All. Cable Socket(300 sq mm) - 24 Nos
		40 mm dia GI Pipe Earthing Device.3mtr. Long- 4 Nos
		Earthing with Materials - 4 Nos
		25x6 mm GI Flat(1.2Kg/mtr)- 40 Kg
		11 KV L.A. 12KV-10KA- 3 nos
		Construction of Cubicle room (12'x12'x10')
		11KV Metering Cubicle -1 no., 11MV Metering Unit -1 no., 3Ph 4W HTTV Meter -2 nos. & AMR Kit -1no.( to be supplied by NESCO)
3	<b>Dismantling of existing network, if required.</b>	Dismantling of existing 55 sq. mm. AAAC - 0.3 km., 9 mtr. RS Joist - 2 nos.,9mtr PSC Pole 300 Kg with all accessories - 3 Nos. etc.
		Transportation of dismantling materials from site to NESCO Store.

**N.B :** 1. The above quantity of materials to be used are tentative against item particulars as mentioned above , may be vary during execution of the shifting work. Any other materials, if required other than the above to be supplied by the agency to complete the work.

2. All MS materials should be hot dip galvanized as per IS : 2629 and Joist poles , channel & angle should be painted by two coat of red oxide primer & aluminium paint.

3. The bidders should be furnished type test reports of offered major materials such as Power Cable, Termination Kits, VCB, Control cable ,LA, HT Stay Set etc to be used in the turnkey project . The bid shall accompanying with type-test reports conducted at Central Power Research Institute / NABL accredited laboratory for offered materials conducted within **Five** years before the date of opening of the tender. Bid not accompanied with type test reports conducted within five years & the drawings of the offered Materials duly approved by the Type Testing Agency shall not be considered for evaluation. For other offered materials should have been Inspected/Tested by any Distribution Utility/ Reputed Private Organization/ State Govt./ Central Govt. or their

undertaking(s)/NABL or CPRI.

4. The bidders should furnish GTP formats duly filled and signed for the offered materials.

### **Methodology:-**

The complete procedures & scope for the execution of the project by the agency are explained herewith;

- i. Detailed survey location for construction of line, metering system and preparation of SLD & BOQ before executing the work. .
- ii. To provide complete manufacture details, testing facilities & scheduled of supply materials from the approved vendors (materials which are to be supplied by the bidder) as per technical specification for obtaining prior approval of the NESCO Utility.
- iii. To provide Engineering drawing, data, operational manual, guaranteed technical particulars etc. wherever applicable for obtaining approval of NESCO Utility prior to execution of work..
- iv) All required materials cover under the turnkey contract shall be supplied by bidder except Metering Unit, Metering Cubicle , HTTV meter & AMR kit which will be provided by NESCO Utility.
- v. Packing and transportation of materials from the manufacturer's works/ NESCO store to the site .
- vi. Receipt, storage, preservation and conservation of equipment at the site.
- vii. Pre-assembly, if any, erection testing and commissioning of all the equipment;
- viii. Reliability tests and performance and guarantee tests on completion of commissioning;
- ix. Loading, unloading and transportation of required materials under scope of executing agency and also materials as provided by NESCO Utility from his Stores/ site.
- x. HT line will be constructed by using underground cables through HDPE pipe , shifting of overhead existing line and installation of Metering equipments .
- xi. Guarding to be provided at busy area, road crossing .
- xii. Concreting of all poles & Stay.
- xiii. Testing, Commissioning of lines / installations.
- xiv. Getting the lines inspected by Electrical Inspector after completion of work including deposit of required inspection fees by own i.e not claiming from NESCO Utility.
- xv. *All expenditure towards inspection of materials at manufacturer's site and inspection of work after completion shall be borne by the executive agency.*
- xvi. Dismantling of existing electrical network , if any and returning dismantled items to the NESCO Utility's stores and cost shall be borne by the executive agency.  
required inspection fees without claim to NESCO Utility.

### **For details the Technical Specification specified :**

#### **2.0.1 SURVEY (detail & check, estimating of quantities & spotting of Poles)**

Walk over survey shall have to be carried out to ascertain the location wise nature of work to be executed.

Bidder may be made field survey of the site before bidding.

**2.0.2 GENERAL:** The Right of way shall be resolved by the contractor and all expenses there of  
Tech. Specification NIT No. NESCO Utility/ **Const<sup>n</sup> of HT Line & SC** / 26/ 24.3.21

shall be borne by him. However, NESCO Utility shall render all helps in co-ordination with law and order and forest department for solving the same.

**2.0.3** Provisional quantities/numbers of different types of work have been estimated and indicated in the BOQ Schedule given. However final quantities for work shall be as determined by the successful bidder, on completion of the detail survey.

**2.0.4** After completing the detailed survey, the contractor shall submit the final survey report for approval of the employer. .

### **3.0 JOIST POLES**

In case of 11KV and LT lines and sub-stations the conventional RS Joist may be used. . The materials must conform to IS: 800. All the test on materials and fabrication etc will be as per the relevant Indian standards.

### **4.0 ERECTION WORK**

When the survey is approved, the contractor shall submit to the employer a complete detail schedule of all materials to be used in the line. Size and length of conductor etc. are also to be given in the list. This schedule is very essential for finalizing the quantities of all line materials. The contractor shall furnish the same.

#### **4.1 SCHEDULE OF ERECTION PROGRAMME**

After due approval of the detailed and check survey, the contractor shall submit to the employer a complete detailed schedule of erection programme with a Bar-Chart for construction of the lines indicating there in the target date of completion.

### **5.0 CONSTRUCTION OF FOUNDATION FOR JOIST**

#### **5.0.1 ERECTION OF POLE, CONCRETING OF POLES AND COMPACTION OF SOIL**

Drawing for the excavation of pits, Foundation of both wet and Black cotton soil is enclosed which are to be adopted. If better design with less volume approved or tested by any other distribution agencies will also be acceptable.

**5.0.2** Following arrangement shall be adopted for proper erection of poles and properly compacting of the soil around the base / foot of the poles, under this package.

(a) Excavation has to done as per the drawing to the required depth and size. After final excavation the pit should be dressed properly so that uneven portion and loose soil should be removed before PCC (M-7.5) i.e 1:4:8 of thickness 75 mm is laid. The base footing of the pole concreting RCC (M-12.5) i.e 1:3:6 has to be done by proper alignment and verticality.

(b) The verticality and leveling of pole/structure should be done by the help of plum bob or with theodolite and leveling instrument.

#### **5.0.3 CEMENT CONCRETE AND BACK FILLING etc.**

##### **A) Materials**

All materials whether to be consumed in the work or used temporarily shall conform to relevant IS specification, unless stated otherwise, and shall be of the best approved quality.

##### **B) Cement**

Cement to be used in the work under the contract shall generally conform to IS:269/455-1989.

Cement bags shall be stored by the contractor in a water tight well ventilated store sheds on raised wooden platform (raised at least 150 mm above ground level) in such a manner as to prevent deterioration due to moisture or intrusion of foreign matter. Cements to be used within three months from the date of manufacture. Sub-standard or partly set cement shall not be used and shall be removed from the site by the contractor at his cost.

C) Coarse Aggregates i.e Stone chips or stone ballast. For M15 concrete (mix 1:2:4) the aggregate will be in the ranges from 12mm to 20mm.size and for M7.5 concrete (mix 1:4:8) these will be from 25mm to 40mm size.

D) **Pole erection**

1. **After proper alignment**, checking of verticality and leveling, the pole or structure should be properly tied before placing of base concrete of required height. Again the verticality and leveling should be checked.

2. **The PCC pedestal concrete** (M-12.5) is to be done by providing good quality of shutters, so that there will no leakage of cement slurry during concreting. The cooping height should be 450 mm above the existing ground level . The top portion of the cooping should be made tapered.

3. **The back filling** of locations should be done by using the excavated soil only in layers (each layer should not be more than 500 mm) by putting water and ramming by using wooden rammers. In no case stone of size more than 75mm used for back filling. Back-filling has to be done 75mm above ground level or as specified.6.

**5.0.4 All the persons** working on poles shall wear safety helmet, safety belt and safety shoes, Similarly all the persons working on ground shall wear safety helmet and safety shoes.

**5.0.4.1. If there is any LT/HT** power line near the vicinity of erection, necessary shutdown of the power line shall be obtained in writing from the concerned Agency in order to avoid electrical hazards caused by accidental touching of stay/Guy ropes with power line.

**5.0.4.2 Safety precaution** Safety shall be given utmost importance during stringing. The following need to be ensured.

**5.0.4.3 Safe working** conditions shall be provided at the stringing site.

**5.0.4.4 Full proof communication** through walky- talkie / mobile phones shall be used in order to avoid any damage to workmen or public on ground.

**5.0.5 11KV & LT lines and Distribution Sub-station with RS Joist**

### **7.01 GI Clamp for HT Stay set :**

HT stay clamp suitable for 150x150 mm Joist pole made out of 50x8 mm GI Flat, confirming to latest IS Specification and .

#### **GUARANTEED TECHNICAL PARTICULARS FOR HV GUY STRAIN INSULATOR (TYPE C)**

<b>Sl.</b>	<b>Particulars</b>	<b>Requirement</b>	<b>Bidder's offer</b>
1	Name of Manufacturer. & Address	To be specified by the bidder	
2	Location of type testing	To be specified by the bidder	
3	Applicable standard	IS: 5300-1969 or the latest version thereof	
4	Nominal System Voltage	11 KV	
5	Highest System voltage	12 KV	
6	Length	140 mm	
7	Diameter	85mm	
8	Cable hole diameter	25 ± 1.5	
9	1min. power frequency withstand Voltage (Dry)	27 KV (rms)	
10	1min. power frequency withstand Voltage (Wet)	13 KV	
11	Minimum failing load	88 KN	
12	Minimum creepage distance	57 mm	
13	Drawing	To be submitted by bidder	
14	Conforming standard	As per IS	

**NB- Every insulator should bear the marking of manufacturer's name and ISI mark**

**Name & Signature of Bidder with seal**

**GURANTEED TECHNICAL PARTICULARS OF 11KV HT STAY SETS**

Sl No.	Item Description	Specified Parameters		Material	Bidder's offer
		Section Tolerances	Fabrication Tolerances		
	Manufacture's Name & Address		To be specified by the bidder		
1	Anchor Plate	8 mm thick +2.5%-5%	450x450mm+1%	GS Plate 8 mm thick	
2	Anchor Rod	18 mm dia +5%- 3%	Length 1800mm + 0.5%	GS Round 18mm dia	
			Rounded Eye 40 mm inside dia +3% Threading 40mm+ 11%-5%	GS Round 18mm dia	
3.	Turn Buckle Bow	18mm dia +5%-3%	995mm+1%	GS Round 18mm dia.	
			Length200mm +1%	GS Channel 100x50x4.7mm	
4.	Eye Bolt Rod	18 mm dia +5%-3%	Length 450mm + 1%	GS Round 18 mm dia	
			Threading 300mm +1% Round Eye 40mm inside dia+3%		
5	Galvanisation thickness	All galvanization shall be carried out in accordance with IS: 2629 . The weight of Zinc deposited shall be in accordance with IS: 2629 and shall not less than 0.61 kg/m <sup>2</sup> with a minimum thickness of 86 microns for items of thickness more than 5 mm, 0.46kg/m <sup>2</sup> (64 microns) for items of thickness between 2 mm & 5 mm& 0.33kg/m <sup>2</sup> (47 microns) for items less than 2 mm thickness.			
a	Anchor Plate				
b	Anchor Rod				
c	TurnBuckle Bow				
d	Eye Bolt Rod				
6	Thimble	2 nos. to be made of 1.5 mm thick G.S Sheet into a size 75x22x40 mm & shape as per standard.			
7	Hexagonal Nut	One G.S Hexagonal Nut confirming to IS:1363 & 1367 with one square washer of size 50x50x6 mm (G.S) along with Anchor Rod.			
8		Two G.S Hexagonal Nuts of suitable size along with Eye Bolt Rod.			

**Name & Signature of Agency with seal**

**GURANTEED TECHNICAL PARTICULARS STAY WIRE (7/10 SWG)**

<b>Sl. No.</b>	<b>Description</b>	<b>Specified</b>	<b>Bidder's offer</b>
1.	Manufacturer's name & address	To be specified by the Bidder	
2	Nominal diameter of wire in mm	3.15	
3	Tolerance in diameter in mm	± 2.5%	
4	Minimum breaking load in Kg	3697.50	
5	Tensile strength Kgf/mm <sup>2</sup>	71.40	
6	Overall diameter of stranded wire in mm	9.45	
7	Sectional Area (in mm <sup>2</sup> .)	70.16	
8	Coating Test		
a	Type of zinc coating whether heavy or light	Heavy	
b	Weight of coating in g/m <sup>2</sup>	476	
9 a	Length of wire in each coil in mtr.	193	
b	Tolerance	± 5%	
10	No. of dips the coating is able to withstand as 18 ± 20°C	3 dip in min.	
11	Adhesion Test (Wrap Test at 1 turn per second coiling while stress not exceeding % nominal tensile strength)		
a	Min. complete turn of wrap	To be specified by bidder	
b	Dia of mandrel on which wrapped	- do -	
12	Bend Test		
a	Angle	- do -	
b	Dia round a format to be bent	- do -	
13	Freedom from defect	- do -	
14	Chemical composition the MS Wire used shall not exceed		
a	Sulphur 0.060%	- do -	
b	Phosphorous 0.065%	- do -	
15 a	Weight of each coil in Kg	70 to 100	
b	Tolerance	± 5%	
16 a	Weight of wire in Kg/Km	465	
b	Tolerance	± 5%	
17	Standard according to which the solid wire is manufactured and tested	ISS: 2141/1992 & ISS: 4826/1979	

**Name & Signature of Agency with seal**

## Guaranteed Technical Particulars for No. 6 G.I. wire

Sl. No.	GENERAL TECHNICAL PARTICULARS	Guaranteed Value	Bidders Offer
	Manufacturer's Name & Address		
1	Nominal diameter of wire in mm	4.88 mm	
2	Tolerance in diameter in mm	$\pm 2.5\%$	
3	Sectional Area (in Sq. mm.)	18.7038	
4	Tensile strength of wire in N/mm <sup>2</sup> / MPa	550-900	
5	Minimum breaking load (KN)	9	
6	Variety Hard/Soft	Soft	
7	Type of Galvanizing	Hot dip heavy coating	
8	Weight of Zinc coating (Gms/Sq. Mtr.)	290	
9	No. of dips the coating is able to withstand as $18 \pm 20^{\circ}\text{C}$	3 dip in Min	
10	Adhesion Test (Wrap Test at 1 turn per second coiling while stress not exceeding % nominal tensile strength)	To be specified by bidder	
	i) Min. complete turn of wrap	do	
	ii) Dia of mandrel on which wrapped	do	
11	Bend Test	do	
	i) Angle	do	
	ii) Dia round a format to be bent	do	
12	Freedom from defect	do	
13	Chemical composition the MS Wire used shall not exceed	do	
	i) Sulphur 0.060%	do	
	ii) Phosphorous 0.065%	do	
14	Weight of wire in Kg/Km	148	
15	Tolerance in wt.	$\pm 5\%$	
16	Standard according to which the solid wire is manufactured and tested	IS: 280/1978 , IS: 4826/1979 , IS: 7887/1975	

**Name & Signature of Agency with seal**

## 40mm dia GI Earthing Device:

### 1. Scope :-

This specification provides for design, manufacturing, testing before dispatch, supply & delivery of Earthing Device (Heavy Duty) (for use in Sub-station earthing).

### 2. APPLICABLE STANDARDS :-

The Earthing Device must be made out of 40 mm nominal Bore & 3.2 mm (Medium Gauge-No minus Tolerance allowed) wall thickness Hot Dip G.I. Pipe (as per IS :- 1239,m Part-1, 1990 & REC construction Standard –J-2) , ISI marked of reputed Make & 3.0 mtrs length tapered finished smooth at one end for a length of 75 mm & Clamp at the other end.

Staggered drills hole of 12 mm Dia of interval of 150mm shall be made before galvanization.

The GI Earthing Clamp/ Strip (C- Clamp Type) is to be of 50mm width, 6mm thickness & flange length of 65 mm in each side. This should be suitable for termination of 4 nos of GI Flat earth electrodes. The Clamp/ Strip & Earthing pipe after fabrication will be hot dip galvanized confirming to IS: 2629/85 with latest amendments. The clamp shall have two holes in both sides suitable for 5/8 x 2” Bolt & provided with two GI bolts& Nuts in each side of 12mm dia 50mm long half threaded with spring washer as per IS: 3043/1982.The galvanization tests are to be conducted as per IS: 2633/72 & IS: 6745/72 & its latest amendments.

### **Guaranteed Technical Particulars of Earthing Device**

(To be submitted along with Offer)

	<b>Par</b>	<b>Bidder's Offer</b>
1.	Location of Factory or Place of Manufacture	
2.	Maker's Name, Address & Country	
3.	Size of	
a	Pipe	
b	Earthing Strips	
4.	Length (3.0 Mtr.)	
5.	Thickness of Pipe	
6.	Galvanization Process	
7.	Galvanization thickness	
a	For Earthing device	
b	For Connecting Flat	
8.	Galvanization tests to be conducted as per ISS	
9.	Any other Particulars ( like details of Clamp/ G.I. Bolts)	
10.	Details of Drawings submitted	

**Name & Signature of Bidder with seal**

## **16 mm dia. Hexagonal Bolts & Nuts and Washer (GI)**

16 mm diameter GI Nuts and Bolts black hexagonal As per IS: 1387 (Part-II) Gr.-4/4.6 of following size. Washers shall be round of thickness 1.5 mm suitable for 16 mm dia. bolts.

### **Specification finished products:**

1. The bolts & Nuts shall be ISI Marked Mild Steel of Black Grade “B” and shall be round with hexagonal head.
  - (i) The Bolts and Nuts shall be manufactured by Hot/Cold forging process neatly and cleanly finished and shall have metric threads as per IS : 4218/1967 with its latest amendments.
  - (ii) The dimensions of the bolts & nuts and tolerances should conform to IS: 1363 with their latest amendments in all respect. The eccentricity and angular errors of various elements shall be within specified limits as per IS: 1367/1967 with its latest amendments the bolts & nuts shall be free from forging and threading defects such as cuts, spats. burns, bulging taper eccentricity, loose fill etc. which may affect their serviceability.
  - (iii) The bolt heads and nuts shall be chamfered on one face only and other face shall be machined made.
  - (iv) Mechanical property requirement of tester shall conform to IS: 1367 (Part-III) 1979 property class 4.6 for bolts & property class-5 for nuts as per IS: 1367 (Part VI) —1980.
  - (v) The bolts & nuts shall be supplied in well-cleaned conditions and suitably protected against corrosion in individual bags of 50 Kgs.

### **ACCEPTANCE TESTS:**

The bidder should furnish test certificate from recognized Govt. Laboratory ( NABL accredited) giving the results of tests as per IS: 1367 (Part-III) —1979 & IS: 1367 (Part-VI) 1980 The test certificate shall be in respect of the following for all sizes of both bolts & nuts as applicable given below:-

- i) Dimensional particulars (Sampling Ifl accordance with IS: 2614 for both bolts & nuts (Tolerance as per drawing).
- ii) Tensile strength test on full size (for bolts minimum 400 NI Sq.mm and for Nuts Proof Stress test Mm 610 N/Sq. mm).
- iii) Power load test on full size bolts and M-12-51400 N for 15 Sec.
- iv) Head soundness tests for bolts (no fracture).
- v) Brinell hardness tests or Rockwell Hardness or Vickers’s Hardness tests for bolts min- 114 & max. 209 or mm. 67 & max. 95 or mm. 120 & max. 220 respectively. For nuts Vickers’s Hardness mm. 130 & max. 302.

**Markings:** On the bolt head, there shall be identification marking of the manufacturer as well as property class ‘4.6’.

If possible property class “5” shall be marked on Nuts also. Further ‘ISI’ mark shall be marked on Gunny Bags for proper identification.

## 100x50x6mm MS Channel

## 75x40x5 mm MS Channel

## 50x50x6 mm Angle

### Technical Specifications :

Clause No.	TECHNICAL SPECIFICATIONS OF MILD STEEL CHANNEL & ANGLE												
1.0	<b>SCOPE</b> This specification covers design, manufacture, testing and dispatch to owner's stores of M.S. Channel & Angle for use in structures in distribution system. The channel & angle are made of Jindal/ SAIL/ TATA												
2.0	<b>APPLICABLE STANDARD</b>  Materials shall conform to the latest applicable Indian standards. In case bidders offer steel section and supports conforming to any other international specifications which shall be equivalent or better than IS, the same is also acceptable.  <table><thead><tr><th>S.No.</th><th>Standard No.</th><th>Title</th></tr></thead><tbody><tr><td>1</td><td>IS: 2062 Grade 'A' Quality</td><td>Specification for M.S.Angles, M.S.Channel</td></tr><tr><td>2</td><td>IS: 2062</td><td>Chemical and Physical composition of material</td></tr><tr><td>3</td><td>IS: 1852</td><td>Rolling and Cutting Tolerances for Hot Rolled Steel products</td></tr></tbody></table>	S.No.	Standard No.	Title	1	IS: 2062 Grade 'A' Quality	Specification for M.S.Angles, M.S.Channel	2	IS: 2062	Chemical and Physical composition of material	3	IS: 1852	Rolling and Cutting Tolerances for Hot Rolled Steel products
S.No.	Standard No.	Title											
1	IS: 2062 Grade 'A' Quality	Specification for M.S.Angles, M.S.Channel											
2	IS: 2062	Chemical and Physical composition of material											
3	IS: 1852	Rolling and Cutting Tolerances for Hot Rolled Steel products											
3.0	<b>GENERAL REQUIREMENTS</b>												
3.1	<b>Raw material</b>  The Steel Sections shall be re-rolled from the BILLETS/INGOTS of tested quality as per latest version of IS: 2830 or to any equivalent International Standard and shall be arranged by the bidder from their own sources. The Chemical composition and Physical properties of the finished material shall be as per the equivalent standards.												

3.2	<p><b>Length</b></p> <p>The GS Flat to be supplied shall be in 5.5 meters length.</p>																												
3.3	<p><b>Weightment</b></p> <p>The weighment of GS Flat shall be witnessed by the consignee at the time of taking delivery. The weight recorded in the material receipt certificate issued by the consignees shall be final.</p>																												
3.4	<p>i) 100x50x6 mm MS Channel - 9.56Kg/mtr.  ii) 75x40x6 mm MS Channel – 7.14Kg/mtr.  iii) 50x50x6 mm MS Angle- 4.5 Kg/ mtr.</p> <p><b>Chemical Composition</b> and Physical Properties of M.S. Angles, M.S. Channels, and M.S.Flat conforming to IS: Conforming to IS:2062/84</p>																												
3.5	<p><b>Chemical Composition</b></p> <table border="0" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; width: 30%;"></th> <th style="text-align: center; width: 30%;"><b>Chemical composition</b></th> <th style="text-align: center; width: 30%;"></th> <th style="text-align: center; width: 10%;"><b>For Fe 410 WA Grade</b></th> </tr> </thead> <tbody> <tr> <td>1 C</td> <td style="text-align: center;">-</td> <td style="text-align: center;">0.23%</td> <td style="text-align: center;">MAX</td> </tr> <tr> <td>2 Mn</td> <td style="text-align: center;">-</td> <td style="text-align: center;">1.5%</td> <td style="text-align: center;">MAX</td> </tr> <tr> <td>3 S</td> <td style="text-align: center;">-</td> <td style="text-align: center;">0.050%</td> <td style="text-align: center;">MAX</td> </tr> <tr> <td>4 P</td> <td style="text-align: center;">-</td> <td style="text-align: center;">0.050%</td> <td style="text-align: center;">MAX</td> </tr> <tr> <td>5 SI</td> <td style="text-align: center;">-</td> <td style="text-align: center;">0.40%</td> <td style="text-align: center;">MAX</td> </tr> <tr> <td>6 CE (Carbon Equivalent)-</td> <td></td> <td style="text-align: center;">0.42%</td> <td style="text-align: center;">MAX</td> </tr> </tbody> </table>		<b>Chemical composition</b>		<b>For Fe 410 WA Grade</b>	1 C	-	0.23%	MAX	2 Mn	-	1.5%	MAX	3 S	-	0.050%	MAX	4 P	-	0.050%	MAX	5 SI	-	0.40%	MAX	6 CE (Carbon Equivalent)-		0.42%	MAX
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3.6	<p><b>Mechanical Properties</b></p> <ol style="list-style-type: none"> <li>1. Tensile strength Kgf/mm<sup>2</sup>- - 410</li> <li>2. Yield stress Min. for thickness/diameter <ul style="list-style-type: none"> <li>&lt; 20 mm - 26 Kgf/mm<sup>2</sup> OR 250 N/ mm<sup>2</sup></li> <li>20-40 mm - 24 Kgf/mm<sup>2</sup> OR 240 N/ mm<sup>2</sup></li> <li>&gt; 40 mm - 23 Kgf/mm<sup>2</sup> OR 230 N/ mm<sup>2</sup></li> </ul> </li> <li>3. Elongation % - 23%</li> <li>4. Bend Test (Internal Dia) - Min-3t</li> </ol> <p style="text-align: center;">(t – is the thickness of the material)</p>																												
3.7	<p><b>Tolerance</b></p> <p>Variation in ordered quantity for any destination and overall ordered quantity be only to the extent of ±2%. Rolling and weight tolerances shall be as per version of IS: 1852 or to any equivalent International Standard.</p>																												

4.0	<p><b>TEST</b></p> <p>Steel Section shall be tested in IS approved Laboratory or Standard Laboratory the Bidder country having all facilities available for conducting all the test prescribed in relevant IS or IEC or to any equivalent International Standard or any recognized and reputable International Laboratory or Institutions.</p> <p>The bidders are required to specifically indicate that;</p> <ul style="list-style-type: none"> <li>i) They hold valid IS (or equivalent IEC) License.</li> <li>ii) Steel Section offered are bearing requisite IS certification or equivalent marks.</li> </ul> <p>The bidders are required to submit a copy of the valid IS (or equivalent IEC) License clearly indicating size and range of product against respective ISS or any equivalent International Standards along with their offer.</p>
5.0	<p><b>MARKING</b></p> <p>It is desirable that the bidder should put his identification marks on the finished material. The mark shall be in “legible English letter” given with marking dies of minimum 18 mm size.</p>
6.0	<p><b>INSPECTION AND TEST CERTIFICATES</b></p> <p>The material to be supplied will be subject to inspection and approval by the purchaser’s representative before dispatch and/or on arrival at the destination. Inspection before dispatch shall not however, relieve the bidder of his responsibility to supply the Steel Sections strictly in accordance with the specification.</p>

## Barbed Wire

### TECHNICAL SPECIFICATION FOR G.I. BARBED WIRE

#### STANDARDS:

Unless otherwise specified elsewhere in this specification, the rating as well as performance and testing of the G.I. Barbed wire shall conform to the latest revisions available at the time of placement of order of all the relevant standards but not limited to as listed below.

- IS:280:1978 Mild steel wire for general engineering purposes (*third revision*)
- IS:1340:1977 Code of practice for chromate conversion coating of zinc and cadmium coated articles and zinc base alloys (*first revision*)
- IS:1521:1972 Method for tensile testing of steel wire (*first revision*)
- IS:1755:1983 Method for wrapping test for metallic wire (*first revision*)
- IS:2633:1986 Method for testing uniformity of coating of zinc coated articles (*second revision*)
- IS:4826:1979 Hot dipped galvanized coating on round steel wires (*first revision*)
- IS:12753:1989 Electro galvanized coatings on round steel wire – Specification

#### 3. GENERAL TECHNICAL REQUIREMENTS:

GI Barbed wire shall be 2 PLY with a 2.5mm diameter. The barbs shall have a 2mm diameter and be 12.5mm

in length. The barbs shall have four points and shall be formed by twisting two point wires, each two turns, tightly around both line wires making altogether four complete turns.

G.I. Barbed wire shall be of type IOWA with size and dimensions as under:-

Line wire - 2.5 mm

Point wire - 2.0 mm

Distance between two bars shall be 75 mm ( + 12 mm ).

#### SPECIFIC TECHNICAL PARTICULARS FOR 2.5 MM X 2.0 MM G.I.BARBED WIRE

Sl.No.	Particulars	Particulars Specified	Bidders Offer
1	Size of wire- mm	Line wire- 2.5 mm + 0.08 mm Point wire- 2.0 mm + 0.08 mm	
2	Type of Barbed Wire	Iowa Type	
3	Tensile strength of line wire	390 to 590 N/mm <sup>2</sup>	
4	Minimum breaking load of completed Barbed wire	3.7 KN	
5	Mass of complete Barbed wire (minimum)	115 gms / Mtr.	
6	Distance between two Barbs	(75 + 12 ) mm	
7	No. of lays between the Barbs ( minimum )	4	
8	Method of Galvanising	Hot dipped according to IS:4826 /1979 with medium coating.	
9	Mass of coating (minimum)	Line wire- 110 gms/Mtr <sup>2</sup> Point wire- 105 gms/Mtr <sup>2</sup> ( testing after barbing )	
10	No. of dips the wire is able to withstand without copper coating	( testing after barbing )	
	A) For Line Wire	2 dip in Min	
	B) For Point Wire	2 dip in Min	

**Signature of the bidder with Seal**

#### **G.I. Flat (25 x 6 mm)**

#### **Technical Specifications**

- Scope :** The specification provides for design, manufacturing, testing before dispatch for Hot dip Galvanized flats of size 25X6 mm .
- MS flat shall conform to IS 2062 & its latest amendments for steel & Galvanization as per IS 4759 & its Latest amendments.
- The flat shall be coated with Zn 98 Zinc grade.
- The minimum Zinc coating shall be 610 gm/sqm.
- Inspection & Rejection :**

- a) The representative of NESCO shall pick up samples at random from the GI Flats offered for carrying out routine tests as per specified IS.
- b) The representative shall make visual inspection on each & every GI flats.
- c) The purchaser reserves the right to reject on inspection after the same is received at destination.

**Guaranteed Technical Particulars 25x6 mm GI Flat**  
( Bidder to be specified)

1. Location of Factory or Place of Manufacture :-
2. Maker's Name, Address & Country:
3. Size of G.I. Flat :
4. Standard Length :
5. Galvanization Process:-
6. Galvanization thickness :-
7. Galvanization tests to be conducted

**Signature of the bidder with Seal**

**TECHNICAL SPECIFICATION FOR 11 KV 10 KA DISTRIBUTION CLASS HEAVY DUTY SURGE ARRESTERS (LIGHTNING ARRESTERS)**

**1.0 SCOPE:**

- 1.1 This specification provides for the design, engineering, manufacture, assembly, stage testing, inspection and testing before despatch, packing, forwarding and delivery of Metal Oxide (gapless) Surge Arresters complete with accessories 11 KV system as specified hereunder.
- 1.2 It is not the intent to specify completely herein all the details of design and construction of Surge Arresters, However, Surge Arresters shall conform in all respects to the high standard of design and workmanship and be capable of performing in continuous commercial operation up to Bidder's guarantee in a manner acceptable to Purchaser, who will interpret the meanings of drawings and specifications and shall have the power to reject any work or material which in his judgment are not in accordance therewith. The Arresters offered shall be complete with all parts, necessary for their effective and trouble free operation. Such components shall be deemed to be within the scope of supply, irrespective of whether they are specifically brought out in the commercial order or not.

## 2.0 STANDARDS:

2.1 The Surge Arresters shall conform to the latest editions and amendments available at the time of supply, of the standards listed hereunder:

S. No.	Standard Ref No.	Title
1.	IEC 99-4	Specification Part. 4 for Surge Arresters without gap for AC system.
2	IS:3070 (Part-III)	Specification for Lightning Arresters for alternating current System
3	IS:2629	Recommended practice for hot dip galvanising of iron and steel.
4	IS:2633	Method for testing uniformity of coating on Zinc coated articles.
5	IS:5621	Specification for large hollow porcelain for use in electrical installation.
6	IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control gear.
7.		Indian Electricity Rules 1956.

Note:

- i) For the purpose of this specification all technical terms used hereinafter shall have the meaning as per IEC specification.
- ii) For the parameters of the Arrester which are not specified in IEC specification for Surge Arresters, the provisions of ISS 3070 (Part.III) shall be applicable.

2.2 Surge Arresters meeting with the requirements of other authoritative standards, which ensure equal or better quality than the standards mentioned above shall also be acceptable. Where the equipment offered by the Bidder conforms to other standards, salient points of difference between the standards adopted and the specified standards shall be clearly brought out in the offer. Four (4) copies of the reference standards in English language shall be furnished along with the offer.

## 3.0. CLIMATIC CONDITIONS:

3.1 The Surge Arresters and accessories shall be suitable for continuous satisfactory operation under climatic conditions listed below.

1. Maximum ambient Air Temperature in shade (deg.C). 50 °C
2. Minimum Ambient Air in shade(deg.C). (-) 5 °C Temperature
3. Maximum daily average ambient air temperature 40°C
4. Maximum relative humidity(%) 100%
5. Height above mean sea level 1000M
6. Maximum wind pressure 260 Kg m<sup>2</sup>
7. Average No. of thunder Storm 70 days.

Days / annum.

8. Average annual rainfall (mm) 1500 mm
9. Average No. of months of tropical monsoon condition p.a. 4

All the electrical devices shall be given tropical and fungicidal treatment to enable their satisfactory operation in the above climatic conditions.

#### 4.0 PRINCIPAL PARAMETERS:

The Surge Arresters offered under this specification shall conform to the parameters given below.

S. No	Particulars	System parameters for 12 KV Distribution type
1	Nominal system voltage (kv rms)	11
2	Highest system voltage (kv rms)	12
3	1.2/50 microsecond impulse voltage with stand level	
a	Transformer and reactors (kvp)	75
b	Other equipment and lines (kvp)	75
4	Minimum prospective symmetrical fault current for 1 second at Arrester location (KA rms)	10
5	Anticipated levels of temporary over voltage and its duration.	
a	Voltage(p.u.)	1.5
b	Duration(Seconds)	1/10
6	System frequency(Hz)	50 +/- 1.5
7	Neutral Grounding	Effectively earthed
8	Number of Phases	Three
Note	1. 1 p.u. =	$12 \times \sqrt{2} \text{KV peak} / \sqrt{3}$

#### 5.0 GENERAL TECHNICAL REQUIREMENTS:

- 5.1 The Surge Arresters shall conform to the technical requirements as per Annexure-A.
- 5.2 The energy handling capability of each rating of Arrester offered, supported by calculations, shall be furnished in the offer.
- 5.3.1 The Station Type Surge Arresters shall be fitted with pressure relief devices and arc diverting ports and shall be tested as per the requirements of IEC specification for minimum prospective symmetrical fault current as specified in Annexure-A.
- 5.3.2 The grading ring on each complete Arrester for proper stress distribution shall be provided if required for attaining all the relevant technical parameters.
- 5.4 PROTECTIVE LEVELS:  
The basic insulation levels and switching impulse withstand levels of the lines and equipment to be protected have been specified in clause 4.0, "Principal Parameters".

The protective characteristics of the Arresters offered shall be clearly specified in the schedule of guaranteed technical particulars.

## **5.6 GENERAL REQUIREMENTS:**

- 5.6.1 The materials and components not specifically stated in this specification but which are necessary for satisfactory operation of the equipment are deemed to be included in the scope of supply unless specifically excluded.
- 5.6.2 Unless otherwise brought out separately by the Bidder in the schedule of deviations the Surge Arresters offered shall conform to the specification scrupulously. All deviations from the specification shall be brought out in the schedule of deviations. The discrepancies between the specification and the catalogues or literature submitted as part of the offer shall not be considered as valid deviations unless specifically brought out in the schedule of deviations.
- 5.6.3 Any deviation which has not been specifically brought out in the schedule of deviations of the Bid Proposal Sheets, shall not be given effect to. The deviations brought out in the schedule shall be supported by authentic documents, standards and other references.
- 5.6.4. Each individual unit of Surge Arresters shall be hermetically sealed and fully protected against ingress of moisture. The hermetic seal shall be effective for the entire life time of the Arrester and under the service conditions as specified. The Bidder shall furnish sectional view of the Arrester, showing details of sealing employed.
- 5.6.5 The bidder shall furnish in the offer, a sectional view of pressure relief device employed in the Station type Surge Arresters offered.
- 5.6.6 The Surge Arresters shall be suitable for hot line washing.

## **5.7 Construction:**

- 5.7.1 All the units of Arresters of same rating shall be interchangeable without adversely affecting the performance.
- 5.7.2 The Surge Arresters shall be outdoor and suitable for pedestal/ clamp type mounting.
- 5.7.3 All the necessary flanges, bolts, nuts, clamps etc., required for assembly of complete Arrester with accessories and mounting on support structure to be supplied by the Purchaser shall be included in Bidder's scope of supply.
- 5.7.4 The drilling details for mounting the Arrester on Purchaser's support shall be supplied by the Supplier.
- 5.7.5 The minimum permissible separation between the Surge Arrester and any earthed object shall be indicated by the Bidder in his offer.

## **5.8. PORCELAIN / POLYMERIC HOUSING:**

- 5.8.1 The housing may be of Porcelain or Polymeric.
- 5.8.2 Where the bidders are quoting for Surge Arresters with Porcelain Housing, all porcelain housings shall be free from lamination cavities or other flaws affecting the maximum level of mechanical and electrical strengths.
- 5.8.3 The porcelain shall be well vitrified and nonporous.
- 5.8.4 The creepage distance of the Arrester housing shall be as per Annexure-A.
- 5.8.5 The porcelain petticoat shall be preferably of self cleaning type (Aerofoil design).  
The details of the porcelain housing such as height, angle of inclination, shape of petticoats,

gap between the petticoats, diameter (ID and OD) etc., shall be indicated by the Bidder in his offer in the form of a detailed drawing.

5.8.6 The Arrester housing shall conform to the requirements of IEC specification.

### **5.9. GALVANISATION, NICKEL PLATING ETC.:**

5.9.1. All ferrous parts exposed to atmosphere shall be hot dip galvanised as per IS:2629 as amended from time to time. Tinned copper / brass lugs shall be used for internal wiring. Screws used for electrical connections shall be either made of brass or nickel plated.

5.9.2. Ground terminal pads and name plate brackets shall be hot dip galvanised.

5.9.3 The material shall be galvanised only after completing all shop operations.

### **5.10. ACCESSORIES AND FITTINGS:**

5.10.1 All necessary accessories and earthing connection leads shall be in the Bidder's scope of supply.

5.10.2 Terminal connector conforming to IS: 5561 shall be supplied along with the arrester.

5.11. The grounding terminal shall be suitable for accommodating Purchaser's grounding connection to steel earth mat.

5.12. Name Plate:

The arrester shall be provided with non-corrosive legible name plate indelibly marked with the following information:

1. Purchaser's Name : **NESCO**
2. Order No.:
3. Manufacturer's name, address, trade mark and identification no. of the Arrester being supplied.
4. Rated Voltage.
5. Maximum continuous operating voltage.
6. Type.
7. Rated Frequency.
8. Nominal discharge current.
9. Line discharge class.
10. Pressure relief current in kA rms.
11. B.I.L. of the equipment to be protected.
12. Year of manufacture.
13. Date of despatch.
14. Date of Expiry of Warranty.

### **6.0. TESTS:**

#### **6.1 TEST BEFORE DESPATCH:**

The Surge Arrester of various rating and accessories shall be subjected at maker's works before despatch, to the following tests as per relevant standards.

#### **A) ROUTINE TEST ON EACH UNIT AS PER RELEVANT STANDARDS:**

1. Measurement of reference voltage.
2. Residual voltage test.
3. Satisfactory absence from partial discharges and contact noises.
4. For arrester units with sealed housing leakage check shall be made on each unit.
5. Current distribution test for multi Column arrester.

## **6.2 TYPE TESTS:**

6.2.1 The bidder shall furnish valid and authenticated type test reports from a Govt. approved / Govt. recognized / NABL Accredited laboratory of similar rating and design of tendered material along with detailed dimensional drawing duly signed & verified by testing agency also showing size & numbers of blocks dimensions contained in the housing along with bid as per requirement of the Tender Specification. Such type test certificates should not be older than 5 years as on the date of bid opening. For this purpose date of conducting type test will be considered. The type test certificates shall be furnished either in original or copy duly attested by notary.

The bidder should furnish documentary evidence in support of the laboratory whose type test have been furnished, that the said laboratory is a Govt. / a Govt. approved / a Govt. recognized / NABL accredited laboratory / ILAC accredited (in case of foreign laboratory).

The bids of only those bidders shall be considered to be meeting the type test criteria who furnishes complete type test certificate with the bid as per above provision.

6.2.2: Following type tests shall be conducted on one unit of each rating as per relevant standard.

1. Insulation withstand test.
2. Residual voltage test.
3. Bending test on arrester housing assembly.
4. Long duration current impulse withstand test.
5. Operating duty test.
6. Pressure relief test (Only for station type)
7. Test of arrester disconnectors (For 9 KV Feeder Type)
8. Artificial pollution test on porcelain.
9. Partial discharge test.
10. Housed arresters.
  - a) Temperature cycle test.
  - b) Porosity test.
11. Galvanising test on exposed ferrous metal parts.
12. Any other type test which are not specified above but covered as per amendment/latest edition of relevant IS/IEC.

## **6.3 TEST ON BOUGHT OUT ITEMS:**

Tests are not required to be performed on bought out equipments/items like, Terminal connector etc. at the works of manufacturer. Furnishing Test Certificate of bought out items from the original equipment manufacturers shall be deemed to be satisfactory evidence. Inspection of the tests at Sub- contractors works will be arranged by the supplier whenever required.

## **6.4 ROUTINE/ACCEPTANCE TESTS:**

The following tests shall be got conducted in presence of purchaser's representative, as per stipulation of the relevant standards. Acceptance tests whenever possible shall be conducted on the complete arrester unit. No. of samples to be selected for acceptance tests shall be nearest lower whole number to the cube root of the number of arresters to be supplied.

1. Measurement of power frequency reference voltage on the complete arrester at the reference current measured at the bottom of the arrester.
2. Lightning Impulse residual voltage.
3. Partial discharge test.
4. Visual inspection & verification of dimension.
5. Special thermal stability test.

6. Galvanising test on Ferrous metal parts.
7. Any other tests as per IS.

**6.5 TOLERANCE ON TEST RESULTS:**

As per relevant standards/specifications.

**6.6. CHECKING AT STORES (TEST AT CTL):**

One out of every 50 nos. Surge Arresters will be selected for checking at Store for visual, dimensional, weight, marking etc. as per relevant ISS/GTP/approved drawing.

**7.0 INSPECTION:**

All the tests (as mentioned at Clause 6.4) and Inspection shall be made at the place of manufacturer unless otherwise especially agreed upon by the bidder and purchaser at the time of purchase. The bidder shall afford the inspection officer(s) representing the purchaser all reasonable facilities without charges, to satisfy him that the material is being supplied in accordance with this specification. The purchaser has the right to have the tests carried out at his own cost by an independent agency whenever there is a dispute regarding the quality of supply.

The Inspection may be carried out by the purchaser at any stage of manufacture/before despatch as per relevant standard.

Inspection and acceptance of any material under the specification by the purchaser, shall not relieve the bidder of his obligation of furnishing material in accordance with the specification and shall not prevent subsequent rejection if the material is found to be defective. The Bidder shall keep the purchaser informed in advance, about manufacturing programme so that arrangements can be made for inspection.

The purchaser reserves the right to insist for witnessing the acceptance/routine testing of the bought out items.

**GUARANTEED TECHNICAL PARTICULARS FOR METAL OXIDE (GAPLESS) SURGE ARRESTERS**

S. No.	Particulars	Requirement of parameters	Bidder's offer
1	Name of Manufacturer. & Address	To be specified by	
2	Location of type testing	To be specified by	
3	Applicable standard	IS:3070 (Part-III) or the latest version thereof	
4	Rated arrester voltage (KV)	11	
5	Maximum continuous operating voltage (MCOV) KV (rms)	12	
6	Installation	Outdoor	
7	Class	<b>Distribution Class</b>	
8	Type of construction	Single column, single phase	
9	Nominal discharge current corresponding to 8 / 20 micro second wave shape (KA peak)	10	
10	Type of mounting	Pedestal	
11	Connection (between phase to earth) / (between phase to phase)	Phase to Earth	

12	Line discharge class	2	
13	Ratio of switching impulse residual voltage to rated voltage of arrester	As per provision of IEC – 99 – 4 (latest amended)	
14	Minimum prospective symmetrical fault current for pressure relief test (KA rms)	40	
15	Terminal connector suitable for the conductor	Up to 100 mm <sup>2</sup> single	
	a)		
	b) Take off	For both vertical & horizontal	
16	Voltage (corona extinction) (KV rms)	Rated voltage of arrester	
17	Partial discharge	As per provision of IEC – 99 – 4 (latest amended)	
18	Whether insulating base and discharge counter with milli ammeter are required	No	
19	Minimum creepage distance of arrester housing	300 mm	
20	Drawing	To be submitted by bidder	

**Name & Signature of Bidder with seal**

## **TECHNICAL SPECIFICATIONS FOR 11KV 185 SQ MM XLPE INSULATED UNDERGROUND CABLES**

### **1.0 SCOPE :**

1.1 This specification covers design, manufacture, inspection, testing and supply of 11KV, 3C X 185 sq. mm. Al. XLPE armoured cable (A2XFY) to destination Station anywhere in the jurisdiction of NESCO Utility for use with effectively earthed distribution system

### **2.0 RATED VOLTAGE**

2.1 The rated voltage of the cable shall be 11000 Volts AC with the highest system voltage of 12000 Volts between phases of the effectively earthed three phase-distribution system.

### **3.0 APPLICABLE STANDARDS:**

3.1 Unless otherwise stipulated in the specifications, the latest version of the following Standards shall be applicable.

- a. IS 8130 – Conductors for Insulated electrical cables and flexible cords
- b. IS 10810 (series) – Methods of tests for cables
- c. IS 10418 – Drums for electrical cables.
- d. IS 7098 (Part 2) – Cross – linked Polyethylene Insulation for Cables.

e. IS 3975 – Specification for mild steel wires, strips and tapes for armoring of cables.

f. IS 5831 – Specification for PVC insulation sheath for electric cables.

Dimensions of protective coverings of cables

Part 1 – Elastomeric and thermoplastic insulated cables.

3.2 The Cables manufactured to any other Internal Standards like BSS, IEC or equivalent standards not less stringent than Indian Standards are also acceptable. In such cases, the Bidders shall enclose a copy of the equivalent international standard, in English language, along with the bid.

#### 4.0 CONSTRUCTION:

4.1 Conductor: - The conductor shall be composed of compacted circular aluminum wires complying with IS 8130.

4.2 Insulation: - The insulation shall be cross linked polyethylene conforming to the following requirements.

SI No	Properties	Requirements
1	Tensile Strength	12.5N/mm <sup>2</sup> , Min
2	Elongation to break	200 percent, Min
	Aging in air oven	135+ <sub>30</sub> C
	a) Treatment : Temperature	7 Days
3	Duration	
	a) Tensile Strength variation	+ 25 percent, Max
	b) Elongation variation	+ 25 percent, Max
4	Hot set	
	a) Treatment : Temperature	200 + 30 C
	Time under load	15 min
	Mechanical stress	20N/cm <sup>2</sup>
	b) Elongation under load	175 percent, Max
	c) Permanent elongation (set) after cooling	15 percent, Max
5	Shrinkage	
	a) Treatment : Temperature	130+ 30 C
	Duration	1 hour
	b) Shrinkage	4 percent, Max
6	Water absorption (Gavin metric)	
	a) Treatment : Temperature	85+ 20 C
	Duration	14 days
	b) Water absorbed	1 mg / cm <sup>2</sup> , Max
7	Volume Resistivity	
	at 270 C	1 x 10 <sup>14</sup> ohm-cm, Min
	at 700 C	1 x 10 <sup>13</sup> ohm-cm, Min

4.3 The screening shall consist of non-metallic semi conducting compound and copper tape, shielded cores laid up with fillers, inner sheath of extruded PVC, Galvanized steel strip Armour and PVC ST-2 overall sheath.

4.4 The cables should be suitable for use in solidly earthed system.

4.5 The 6.35/11KV underground cables shall be manufactured to the highest quality, best workmanship with scientific material management and quality control. The bidder shall furnish the quality plan, giving in detail the quality control procedure / management system.

4.6 The successful Bidder shall give sufficient advance notice to the purchaser of not less than fifteen days to arrange for stage inspection and inspection of quality assurance program during manufacture, at the works.

## 5.0 SYSTEM DETAILS

General Technical particulars

General Technical particulars		
Sl No	Particulars	Values
1	Nominal system voltage (rms) (U)	11KV
2	Highest system voltage (rms) (Um)	12KV
3	Phase to Earth voltage (rms) (U0)	6.35 KV
4	Number of Phase	3
5	Frequency	50Hz
6	Variation in Frequency	+ / - 3%
7	Type of Earthing	Solidly Earthed
8	Basic impulse insulation level (1.2/50 XS wave)	75KV
9	Total relay & circuit breaker Operating time	15-20 cycles
10	One Minutes power frequency withstand voltage	28 KV rms

## 6.0 INSTALLATION CONDITIONS:

6.1 The cables are laid directly buried in ground. The Nominal depth of laying is up to minimum 1.2Mtr (from top of ground to centre of cable). However, in trench less horizontal bore method, the bore can go up to a depth of a maximum of 2 meter. Nature of soil is heterogeneous, sandy, Soil resistivity varies between 18 to 100 ohmmeter and the Thermal resistivity is around 1200 to 1500 C/ Cm/w.

## 7.0 CLIMATIC CONDITIONS:

7.1 The climatic conditions where these 11KV cables will be installed are as under : Climatic conditions

Sl No	Particulars	Details
1	Location	North-Eastern Odisha under NESCO Utility Jurisdiction
2	Max Daily average air temp	45°C
3	Minimum ambient air temp :	10°C
4	Ground temperature at depth of laying assumed	350 (Max) 50 C (Min)
5	Isoceraunic level	45

6	Avg. annual rainfall	2500 mm
7	Avg. number of rainy days per annum:	90
8	Climate	Tropical moderately hot and humid. likelihood of subsoil water at certain location at the depth of burial of cables
9	Soil	Normally dry

## 8.0 DESIGN CRITERIA:

- 8.1 The cables that are covered in these specifications are intended for use in the North Eastern belt of state of Odisha for Power distribution purposes, under the climatic conditions and installation conditions described in the technical specification.
- 8.2 Any technical features, not specifically mentioned here, but is necessary, for the good performance of the product, shall be incorporated in the design. Such features shall be clearly brought out under Technical deviations schedules only, in the offer made by the bidder, giving technical reasons, and justifying the need to incorporate these features.'
- 8.3 For continuous operation of the cables, at specified rating, the maximum conductor temperature shall be limited to the permissible value as per the relevant standard, generally not exceeding 900C under normal operation and 250cC under short-circuit conditions.
- 8.4 The cables in service will be subject to daily load cycles, of two peaks during a day; morning peak and evening peak, with around 50% loading during the nights.
- 8.5 The materials used for outer sheaths shall be resistant to oils, acids and alkalis.
- 8.6 The cables shall have the mechanical strength required, during handling and lying.
- 8.7 The cables shall be designed to withstand the thermo-mechanical forces and electrical stresses during normal operation and transient conditions.
- 8.8 The cables shall be designed to have a minimum useful life span of Thirty years.

## 9.0 MANUFACTURE PROCESS:

- 9.1 Cross-linking of the insulation materials (pre compounded polyethylene) shall be conforming to IS :7098 (Part-II)
- 9.2 The conductor screen shall be extruded semi conducting compound. The insulation screen shall consist of the nonmetallic part, extrude semi conducting compound with non-magnetic metallic part. The XLPE insulation and the shield for conductor and insulation shall be extruded in one operation.

## 10.0 MATERIALS

- 10.1 Conductor: - The conductor shall be of standard construction. The material for conductor shall consist of the plain aluminum of H2 or H4 grade as per clause – 3 of IS 8130 / 1984. 10.2 The Number of wires in the conductor, shall be not less than the appropriate minimum number given in table – 2 of IS 8130 / 1984.

## 11.0 SCREENING:

- 11.1 The conductor screening shall be provided over the conductor by applying non-metallic semi-conducting compound. The metallic screen shall withstand the operating temperature of the cable and shall be compatible with the insulating material.

11.2 The insulation screen shall be applied over the insulation. The insulation screening shall consist of two parts; namely metallic and non-metallic. The non-metallic part shall be applied directly over the insulation of each core and shall consist of a semi conducting tape and extruded semi conducting compound with a semi conducting coating. The metallic part

of the insulation screen shall consist of either tape, or braid, or concentric serving of wires or a sheath; shall be non-magnetic and shall be applied over the non-metallic part.

**12.0 CORE IDENTIFICATION:**

12.1 The core identification for 3 core cables shall be provided, by suitable means, like, by application of colored stripes, or by numerals or by printing on the cores as per clause 13 of IS : 7098 – Part 2.

12.2 For identification of different coloring of XLPE insulation, or by using colored strips, red, yellow and blue colors respectively shall be used to identify the phase conductors.

**13.0 LAYING UP OF CORES:**

13.1 For multicore cables, the cores shall be laid together with a suitable right hand lay. The interstices at the center shall be filled with a non hygroscopic material.

**14.0 INNER SHEATH (COMMON COVERING)**

14.1 The laid up cores shall be provided with inner sheath applied either by extrusion or by wrapping. It shall be ensured that the shape is as circular as possible. The inner sheath shall be so applied that it fits closely on the laid up cores and it shall be possible to remove it without damage to the insulation.

14.2 The thickness of the inner sheath (common covering) shall be given as follows:

Calculated diameter over laid up cores in accordance With 15.3 of IS 10462 (Part 1) – (mm)		Thickness of inner sheath (mm)
Over	Up to and including	
-	25	0.3
25	35	0.4
35	45	0.5
45	55	0.6
55	-	0.7

When one or more layers of binder tapes are applied over the laid up cores, the thickness of such tapes shall not be construed as a part of inner sheath.

14.3 For multi core cables, the interstices at the center shall be filled with a non-hygroscopic material. The interstices around the laid up cores shall be covered with PVC compound type ST-2. This will form the Inner sheath for multi core-single core cables.

**15.0 ARMOURING:**

15.1 Armoring shall be applied over the inner sheath as closely as practicable. The Armour shall be galvanized steel strip complying with the requirements of IS 3975. A binder tape may be applied on the Armour. The direction of the lay of the amour shall be left hand. For double armored cables, this requirement applies to the inner layer. The outer layer shall be applied in the reverse direction to the inner layer, and there should be a separator of the non hygroscopic material; such as plastic tape, bituminized cotton tape, rubber tape, proofed tape between inner and outer layers of Armour.

15.2 The dimensions of galvanized steel strips shall be as below:

Calculated diameter over Armour [IS 10462 Part 1] (mm)		Nominal thickness of Steel Strip(mm)
Over	Upto and including	
-	13	-
13	25	0.8
25	40	0.8
40	55	1.4
55	70	1.4
70	-	1.4

15.3 The joints in the strips shall be made by brazing or welding and the surface irregularities removed. A joint in the strips shall not be less than 300 mm away from the nearest joint in any other strip in the completed cable.

15.4 Bidders shall furnish the calculation / data sheet for the short circuit carrying capability of the Armour.

### 16.0 OUTER SHEATH:

16.1 The outer sheath over the Armoring shall consist of poly vinyl chloride (PVC) compound, conforming to the requirements of type ST-2 of IS 5831. Suitable additives shall be added to give anti termite protection & rodent and shall be above flame retardant.

16.2 The minimum thickness of the PVC outer sheath shall not fall below the following value by more than 0.2 mm + 0.2 ts

Calculated diameter under the outer sheath [IS 10462 Part 1] - mm		Nominal thickness of the Outer sheath (ts) - mm
Over	Upto and including	
-	15	1.8
15	25	2
25	35	2.2
35	40	2.4
40	45	2.6
45	50	2.8
50	55	3
55	60	3.2
60	65	3.4
65	70	3.6
70	75	3.8
75	-	4

### 17.0 IDENTIFICATION:

17.1 The outer sheath shall have the following information embossed or indented on it; the manufacturer's name or trade mark, the voltage grade, the year of manufacture and the letters "NESCO Utility". The identification shall repeat every 300/350-mm along the length of the cable.

17.2 Note: The outer sheath of the cable should be embossed with "NESCO Utility"

#### **18.0 INSPECTION AND QUALITY CONTROL:**

18.1 The Bidder shall furnish a complete and detailed quality plan for the manufacturing process of the cable. All raw materials shall conform to relevant applicable standards and tested for compliance to quality and requirement. During the manufacturing process, at all stages, inspections shall be made to check the physical and dimensional parameters, for verification to compliance to the standards. The bidder shall arrange, for inspection by the purchaser, during manufacture, if so desired by the purchaser, to verify the quality control process of the Bidder.

#### **19.0 TYPE TESTS:**

19.1 The offered cables with same designs shall have been type tested and Test certificates shall not be later than 5 years on the date of bid opening. Otherwise the supplier / Turnkey contractor shall arrange for type testing at his own cost.. The supplier /Turn Key contractor shall conduct all type tests as per IS : 7098 part-II 1985, with up to date amendments or equivalent International standard, and supplies made only after approval of test reports from the purchaser.

19.2 All type tests if required, routine acceptance test shall be conducted in the presence of the purchaser / representative.

19.3 The supplier shall give 15 days advance notice for inspections, and witnessing of tests by the purchaser or his representative.

19.4 The following type tests will be conducted on the cable if the type test certificates are more than 5 years old

- (a) Test on conductor.
- (b) Test on Amour.
- (c) Test for thickness of XLPE insulation and inner and outer sheaths
- (d) Physical test on XLPE insulation.
- (e) Physical test for outer sheath
- (f) Bleeding and blooming test for outer sheath
- (g) Partial discharge test.
- (h) Bending test
- (i) Di-electric power factor test
  - i. As a function of voltage
  - ii. As a function of temperature
- (j) Insulation resistance (volume resistivity) test
- (k) Heating cycle test

(l) Impulse withstand test

(m) High voltage test

(n) Flammability test

19.5 The following test shall be performed successfully on the same test sample of completed cable, not less than 10 M in length between the test accessories:

I. Partial discharge test

II. Bending test followed by partial discharge test

III. Dielectric power factor as a function of voltage.

IV. Dielectric power factor as a function of temperature

V. Heating cycle test followed by dielectric power factor as a function of voltage and partial discharge tests.

VI. Impulse withstand test

VII. High voltage test.

## **20.0 ACCEPTANCE TEST:**

20.1 The sampling plan for acceptance test shall be as per IS 7098 part-II, Appendix 'A'

20.2 The following shall constitute the acceptance test.

a) Tensile test for aluminum

b) Wrapping test for aluminum

c) Conductor resistance test

d) Test for thickness of insulation

e) Test for thickness of inner and other sheath

f) Hot-set test for insulation

g) Tensile strength and elongation at break test for insulation and outer sheath.

h) Partial discharge test (on full drum length).

i) High voltage test.

j) Insulation resistance (volume resistivity test).

## **21.0 ROUTINE TEST:**

21.1 The following shall constitute routine tests :

a) The following shall constitute routine tests:

b) Conductor resistance test

c) Partial discharge test on full drum length

d) High voltage test.

## **22.0 PACKING:**

22.1 The cables, as per specified delivery lengths, shall be securely wound/packed in non-returnable, well seasoned sturdy wooden drums, with strong reinforcement so as to withstand rough handling during transport by rail, Roads etc., The packing should withstand storage conditional in open yards. The cable drums shall conform to IS 10418 1982 or equivalent standard.

22.2 The drawings of the cable drums with full detail shall be furnished, and got approved before dispatch.

## **23.0 SEALING OF CABLE ENDS ON DRUMS:**

23.1 The cable ends shall be sealed properly so that Ingress of moisture is completely prevented. The individual core endings shall be sealed effectively with water resistant compound applied over the core ad provided with a heat shrinkable or push-on or Tapex or cold shrinkable type cap of sufficient length with adequate cushion space so that the conductor does not puncture the cap in case of movement of the core during unwinding or laying. Before sealing, the semi conducting layer on the cores may be removed for about 2 mm at each end, to facilitate checking the insulation resistance from one end, without removing the sealing cap at the other end.

23.2 The three cores should have an overall heat shrinkable or push-on or Tapex or cold shrinkable type cap with adequate end clearance, and sufficient cushioning to prevent puncturing of the overall sealing cap due to stretching of the cores. The sealing cap shall have sufficient mechanical strength and shall prevent ingress of moisture into the cable.

The ends of single core cable shall also be sealed on the same lines to prevent entry of moisture.

## **24.0 CABLE LENGTHS:**

24.1 The cables shall be supplied in continuous lengths of 300M in case of 3 core cable with tolerance of + or – 5% of drum length. It is preferable to manufacture the cable to required lengths as required by the field conditions to have minimum joints. The turn key contractor will furnish the required drum lengths in advance

## **25.0 QUANTITY TOLERANCE**

A +3% tolerance shall be allowed on the ordered quantity.

## **26.0 MARKING:**

26.1 The packed cable drum shall carry the following information, clearly painted or stenciled

- a) The letters NESCO Utility
- b) Reference to Standard and ISI mark
- c) Manufacturer's Name or trade mark.
- d) Type of cable & voltage grade
- e) Number of cores
- f) Nominal cross-sectional area of conductor.
- g) Cable code
- h) Length of cable on the drum
- i) Direction of rotation
- j) Gross weight

k) Country of Manufacture

l) Year of Manufacture

m) Purchase order and date

n) Address of consignee

## 27.0 GUARANTEED TECHNICAL PARTICULARS:

Guaranteed technical particulars of the cables to be furnished with the Bid are enclosed.

## 28.0 DRAWING & LITERATURE

28.1 The following shall be furnished along with the tender

- a) Cross sectional drawings of the cables, giving dimensional details for each size of cable.
- b) An illustrated literature on the cable, giving technical information, on current ratings, cable constants, short circuit ratings, de-rating factors, for different types of installation, packing date, weights and other relevant information.

### GURANTEED TECHNICAL PARTICULARS OF 11KV XLPE CABLE (ARMOURED) (TO BE FURNISHED BY THE BIDDER)

Sl. No.	Particulars	Bidder's Offer
1	CABLES	3Cx185 mm <sup>2</sup>
a)	Manufacturer	
b)	Trade Name	
2	Type of Cable	
3	Applicable specification & Standards	
4	Voltage Class	
5	Whether suitable for extrusion technique is employed in the manufacture of conductor screen	
6	Whether triple extrusion technique is employed in the manufacture of conductor screen	
7	Permissible voltage and frequency variation for satisfactory operation	
8	Continuous Current Rating for standard conditions indicated in specifications:	
a)	Air (450 C Ambient)	
b)	In Ground (350 C)	
c)	In Duct	
d)	In Trench	
9	De-rating factors for various laying conditions	
10	Conductor	
a)	Material	
b)	Shape of conductor	
c)	Nominal area of cross section	
d)	Number of strands per core	
e)	Diameter of Wire (before compacting and stranding)	
f)	Diameter and size of conductor	
11	Conductor Screening	
a)	Type	

b)	Material	
c)	Nominal thickness	
d)	Continuous working temperature	
e)	Maximum allowable temperature at the termination of short circuit	
12	Insulation	
a)	Material	
b)	Thickness of Insulation	
c)	Thickness of Insulation between cores	
d)	Thickness of Insulation between cores and inner sheath	
e)	Tolerance of thickness in insulation	
f)	Diameter of core over insulation	
13	Specific Insulation Resistance at 900C	
14	Process of curing	
15	Whether XLPE Insulation filled or unfilled	
16	Insulation Screening:	
a)	Material	
b)	Thickness	
c)	Thickness of semi conducting part	
d)	Thickness of metallic part	
e)	Size of copper tape	
f)	Whether overlapping provided	
g)	Current carrying capacity for continuous rating	
h)	Current carrying capacity for short circuit rating for 1 minutes	
i)	Diameter of cable over screening	
j)	Whether insulation screen is removable without the application of heat	
17	Inner Sheath	
a)	Material	
b)	Extruded	
c)	Minimum thickness	
d)	Diameter of cable over inner sheath	
18	Armoring:	
a)	Material	
b)	Type of Armouring	
c)	Diameter of wire	
d)	Whether galvanized	
e)	Diameter of cable over Armouring	
f)	Current carrying capacity of Armor	
19	Outer Sheath:	
a)	Material	
b)	Minimum thickness of sheath	
c)	Tolerance over thickness of sheath	
d)	Overall diameter of cable	
20	Scheme for identification of cable	
21	Allowable/attainable maximum conductor temperature when carrying rated current continuously	

22	Cable constants:	
a)	DC Resistance per core 200 C	
b)	AC Resistance per core at operating temperature	
c)	Reactance	
d)	Capacitance	
e)	Insulation Resistance at 270C	
f)	Loss tangent	
g)	Dielectric constant – Maximum cable charging current at normal operating voltage	
23	Factory Tests (Enumerate in detail for each type of cable)	
24	Is the offered cable guaranteed to safely withstand continuous conductor temperature at 900C and also safely withstand temperature upto 1300C for a duration of one hundred hours per year.	
25	Are the offered Three core cable guaranteed to perform satisfactorily under installation conditions specified? If 'Yes' furnish relevant calculations in support including the following data:	

**Signature of Bidder with Seal**

# **TECHNICAL SPECIFICATION FOR 11 KV OUTDOOR VACUUM CIRCUIT BREAKERS**

## **1. SCOPE**

- 1.1 This specification covers design, engineering, manufacture, testing, inspection before dispatch packing, forwarding, transportation, insurance during transit, delivery to site/ stores of 11 KV Outdoor Vacuum Circuit Breakers for use the 33/11KV primary substations for transformer protection under the distribution networks of NESCO.
- 1.2 All vacuum circuit breakers must be manufactured by ISO 9000 certified Organization and shall have been type tested at CPRI or any NABL Accredited laboratory/PHELA/KERI/KEMA/CESI laboratory within five years as on the date of bid opening and in satisfactory operation for a period not less than three years. The Bidder shall demonstrate compliance with this requirement by supplying with the bid, copies of the type test certificates together with performance certificates from purchasers/ users.
- 1.3 The scope of supply includes the provision of type tests at CPRI or any NABL Accredited laboratory/PHELA/KERI/KEMA/CESI laboratory within last five years.
- 1.4 The scope also includes the circuit breaker with current transformers, supporting structures, operating mechanism, local/ remote control cabinet, relay control panel, foundation bolts, all the accessories and auxiliary equipment mandatory spares and special tools for satisfactory installation and operation.
- 1.5 The circuit breakers shall conform in all respects to the highest standards of engineering, design, workmanship, this specification and the latest revisions of relevant standards at the time of offer and the purchaser shall have the power to reject any work or materials, which, in his judgment, is not in full accordance therewith.

## **2. STANDARDS**

Except where modified by this specification, the circuit breakers and the accessories shall be designed, manufactured and tested in accordance with latest editions of the following standards.

<b>IEC/ISO/BS</b>	<b>IS</b>	<b>Subject</b>
IEC: 56 IEC:62271-100& 200	IS: 13118	High voltage alternating current circuit breakers general requirement.
IEC: 694	IS: 12729	Common clauses of high voltage switch-gear and control gear standards (for voltage exceeding 1000 V).
IEC: 60	IS: 9135	High Voltage testing techniques.
IEC: 427	IS: 13516	Method of synthetic testing of HV .A.C circuit breakers.
IEC: 1233		HV. AC. Circuit breakers- inductive load switching.
IEC: 17A/CD:474		HV. AC. Circuit breakers- capacitive switching.
IEC: 529	IS: 13947	Degree of protection provided by enclosure.
IEC: 137	IS: 2099	Insulating bushing for A.C. voltages above 1000V
IEC: 233	IS : 5621	Hollow insulators for use in electrical equipment & testing.
IEC: 273	IS: 5350	Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000V.
IEC: 815	IS: 13134	Guide for selection of insulators in respect of polluted conditions.
IEC: 34	IS: 996	A.C motors
ISO: 1460 BS: 729	IS: 2629	Hot dip galvanizing
	IS: 2633	Method of testing uniformity of zinc coated articles.
	IS: 5	Colour for ready missed paints and enamels
	IS: 6005	Code of practice for phosphating or iron and steel.
IEC: 227	IS: 1554	P.V.C Insulated cables for voltages up to and including 1100 Volt.
IEC: 269	IS: 13703	Low voltage fuses for voltages not exceeding 1000volt.
ISO: 800	IS: 1300	Phenolic moulding materials.
	IS: 13118	Guide for uniform marking and identification of conductors and apparatus terminals.
IEC: 185	IS: 2705	Current transformers.
IEC: 296	IS: 335	Specification for unused insulating oil for transformer and switchgear.

CBIP Technical Report No. 88 revised July, 1996 read with amendment issued (April, 99, September, 99 and also any other amendment thereafter)	Specification for AC Static Electrical Meter.
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This list is not to be considered exhaustive and reference to a particular standard or recommendation in this specification does not relieve the Supplier of the necessity of providing the goods and services complying with other relevant standards or recommendations.

### 3. REQUIREMENTS

The circuit breakers to be supplied against this specification shall be required to control the secondary side of 33/11 KV power transformers in the primary sub-stations or Bus coupler or the outgoing feeders in these sub-stations. The circuit breakers shall be suitable for 3 phase 50Hz solidly grounded neutral system and shall have normal current carrying capacity and symmetrical short circuit current breaking capability as mentioned hereunder.

The required 11 KV Vacuum Circuit Breakers suitable for outdoor installations are to be quoted by Manufacturers only with a valid ISO 9000 certification.

#### 3.1 BASIC TECHNICAL REQUIREMENTS:

The vacuum circuit breakers are required to meet the following basic technical requirements. (Reference standards IEC: 56,IEC:62271-100&200, IS:13118 and associated standards listed in this specification.

##### Basic Technical Requirements

Sl. No	Particulars	Requirements
1	Service type	Outdoor
2	No. of Poles	3
3	Nominal system voltage	11 KV
4	Highest system voltage	12 KV
5	Rated normal current at 50 <sup>0</sup> C	
i)	For Bus-bar of Circuit Breaker	800 A
ii)	For Interrupter	800 A
iii)	For Outgoing Feeders/Transformer	800 A
6	Rated short circuit breaking current (rms)	25KA
7	Rated short circuit making current (peak)	63KA
8	Rated short time current withstand capability for 3 sec.	25KA
9.	Rated insulation level:	
i)	One minute power frequency withstand voltage to earth (wet and	28 KV

	dry) rms	
ii)	Impulse withstand voltage to earth with 1.2/50µsec, wave of +ve and –ve polarity (Peak)	75 KV
10	First – pole – to clear factor	1.5
11	Rated operating sequence (for auto reclosing)	O-0.3 Sec- CO-3 min-CO
12	Maximum break time	3 cycles
13	Rated out of phase breaking current	25% of the symmetrical short circuit breaking current
14	Maximum pole scatter	10 mille seconds
15	Rated Auxiliary supply for spring charge motor, lamp & heater circuit.	230V A.C
16	Rated supply voltage for trip/close coil	24V D.C
17	Minimum creepage distance (mm)	350 mm
18	Minimum protected creepage distance (mm)	280 mm

#### 4. SERVICE CONDITIONS:

The service conditions shall be as follows:

◆	Maximum a altitude above sea level	1,000m
◆	Maximum ambient air temperature	50 <sup>0</sup> C
◆	Maximum daily average ambient air temperature	35 <sup>0</sup> C
◆	Minimum ambient air temperature	5 <sup>0</sup> C
◆	Maximum temperature attainable by an object exposed to the sun	60 <sup>0</sup> C
◆	Maximum yearly weight average ambient temperature	32 <sup>0</sup> C
◆	Maximum relative humidity	100%
◆	Average number of thunderstorm days per annum (isokeraunic level)	70
◆	Average number of rainy days per annum	120
◆	Average annual rainfall	1500mm
◆	Maximum wind pressure	260Kg/m <sup>2</sup>

#### 5. 11 KV VACUUM CIRCUIT BREAKERS

##### 5.1 General

The circuit breakers shall be structure mounted open type with vacuum as interrupting media incorporating separate interrupters of **800 A** rating for each phase mounted on single frame. There shall be a common drive mechanism actuating the interrupters, which must work in synchronism. These breakers shall be provided with suitable local control while provision shall be made for remote control.

The circuit breakers shall be fitted with spring mechanism. The inherent design of these circuit breakers shall be such that they shall satisfactorily perform all test duties and interrupt out-of-phase current and produce very low over voltage (<2.0p.u.) on all switching circuits, capacitive and inductive to IEC:56, IS:13118 and other associated standards mentioned in the clause of this specification.

The terminal pads shall have silver-plating of at least 50 micron thickness. The design of the circuit breakers shall be such that inspection and replacement of contacts, coils, vacuum bottles and any worn or damaged components can be carried out quickly and this ease. The contact gaps shall be adjustable to allow for wear.

The mechanism and the connected interrupters shall satisfy the mechanical endurance requirements of IEC: 56, IS: 13118 and all additional requirements specified herein.

## 5.2

### **Porcelain Insulator**

External parts of the circuit breakers, which are under continuous electrical stress, shall be of hollow porcelain. The creepage and flashover distance of the insulators shall be dimensioned and the type and profile designed in accordance with IEC:815 or IS: 13134 and shall be suitable for the worst environmental conditions specified in this specification. The creepage distance across the interrupting chambers shall suite the outdoor service conditions mentioned in the relevant standards for heavily polluted atmosphere and shall be not less than 350 mm with minimum protected creepage distance 280 mm. Internal surfaces of hollow insulators shall also be glazed. The insulators shall comply with IS:5621 and tested in accordance with IEC:233.

All porcelain whether, used on the interrupting chamber or on the support insulator shall have the following properties:

Higher strength, homogeneity, uniform glaze, free from cavities and other flaws and high quality uniform finish porcelain components and shall withstand the maximum expected static and dynamic loads to which the circuit breakers may be subjected during their service life.

## 5.3

### **Interrupting media**

#### 5.3.1

##### **Vacuum:**

In vacuum circuit breakers, facilities shall be provided for monitoring the contact erosion and any change in contact gap. The vacuum bottles shall be easily replaceable on site and the mechanism shall be conveniently adjustable to permit resetting the contact gap.

The vacuum circuit breaker poles shall be sealed to prevent contamination of the spaces surrounding the interrupters. The Bidder shall demonstrate how this is achieved by supplying technical details with the bid.

## 5.4

### **Auxiliary contracts**

12 auxiliary contacts (6N.O.+6N.C.) of 24 Volt D.C grade and 10 amps DC rating shall be provided in each circuit breaker.

## 5.5

### Indication

A mechanically operated circuit breaker position indicator of non corroding material shall be provided in a location visible from the operating side of the breaker without the necessity to open the mechanism door. The word „OFF“ in white letter on green background shall be used to indicate that the breaker is in the opening position and the word „ON“ in white letters on a red background to indicate that the breaker is in the closed position. The drive for the device shall be positive in both directions and provision shall be made for local and remote electrical indication. Indication of spring charging condition shall be provided as mentioned in this specification. Mechanical counters to record the number of closing operations shall be provided for each circuit breaker mechanism.

## 5.7 Operation and controls

The breaker shall normally be operated by remote electrical control with electrical tripping by shunt trip coil. Provision shall be made for local electrical operation and mechanical operation.

The following facilities shall be provided in the circuit breaker local control cabinet:

- LOCAL/ REMOTE selector switch of stay put type. The selection of „local“ operation shall inhibit the operation of the breaker from any remote source.
- ON/NEUTRAL/ OFF control switch or ON and OFF push buttons. The push buttons shall be momentary contract type with rear terminal connections. The close push button shall be of green colour and the open push button red colour.
- MECHANICAL EMERGENCY TRIP DEVICE: suitable for manual operation in the event of failure of electrical supplies. The device shall be accessible without opening any access doors and distinctly labelled. It shall be shrouded and protected against inadvertent operation.
- Means shall be provided for manual operation of these circuit breakers during failure of auxiliary power in addition to electrical operation.
- Means shall be provided to prevent the mechanism from responding to a close signal when the trip coil is energized or to reclosing from a sustained close signal either opening due to a trip signal or failure to hold in the closed position.

The circuit breaker shall be able to perform 10,000 operating cycles at no load in accordance with IEC: 17A/474/CD for circuit breakers for auto reclosing duties.

## **6. CURRENT TRANSFORMERS**

Current transformers, three per circuit breaker, shall be of outdoor, single phase oil immersed dead tank type and shall comply with IEC:185 and IS:2705, suitable for operation in hot and humid atmospheric conditions described in service condition. They shall be mounted on the bracket. The CT tank should be Hot Dip galvanized as per relevant ISS to prevent corrosion of all exposed metal parts.

### **6.1 Core**

High grade non- ageing cold rolled grain oriented (CRGO M4 or better grade) silicon steel of low hysteresis loss and permeability shall be used for the core so as to ensure specified accuracy at both normal and over currents. The flux density shall be limited to ensure that there is no saturation during normal service.

The instrument security factor of the core shall be low enough so as not to cause damage to the instruments in the event of maximum short circuit current.

### **6.2 Windings**

The secondary windings shall be made of electrolytic copper with suitable insulation. The conductor shall be of adequate cross- section so as to limit the temperature rise even during short circuit conditions. The insulation of windings and connections shall be free from composition liable to soften coze, shrink or collapse during service.

Polarity shall be indelibly marked on each current transformer and at the lead and termination at associated terminal blocks. CTs with multi ratio winding shall be clearly tabulated to show the connections required for different ratios. Similar numbers shall be marked on terminal block arrangement and wiring diagram. Apart from the above marking and those to be provided as per IEC 185 or IS 2705, other markings shall be provided in consultation with owner.

The continuous current rating of the primary winding shall be one hundred and fifty percent of the normal rated current. Secondary windings of current transformers shall be used for metering, instrumentation and protection and shall be rated for continuous current of one hundred and fifty percent of normal rated current of primary winding.

### **6.3 Construction**

The current transformer enclosures shall be made of high quality steel and shall be hot dip galvanized and shall be able to withstand and stresses occurring during transportation and the terminal and mechanical stresses resulting from maximum short circuit current in service. The primary winding and terminals shall be in a tank and supported by a hollow porcelain insulator. The secondary connection shall be conducted through the hollow insulator and terminated in a terminal box mounted on the base plate.

#### **6.4 Hermetic sealing**

Each current transformer shall be supplied filled with insulating oil complying with IEC: 296 or IS: 335 and shall be hermetically sealed to prevent atmosphere coming in contact with oil, avoiding frequent filtration and change of oil. Nitrogen or any oil inert gas above the oil level shall be provided to permit expansion and contraction of oil without any contact with the atmosphere.

The current transformers shall have provision for draining and re-filling insulation oil after drying.

#### **6.5 Insulating oil**

The current transformer shall be complete with new insulating oil. The quantity of insulating oil for first filling of the equipment and complete specification of oil proposed to be used shall be stated in the bid. The oil shall conform to the requirements of latest issue of IEC: 296 or IS: 335.

#### **6.6 Fittings and accessories**

Fittings and accessories listed below shall be supplied with each current transformer:

- Oil level gauge;
- Oil filling hole and cap;
- Pressure relief device;
- HV terminal connectors;
- Two earthing terminals and strips with necessary nut, bolts and washers;
- Name and rating plate;
- Terminal box with LV terminal connections;
- Mounting nuts, bolts and washers;

Any other fittings deemed essential by the Supplier shall also be supplied with each current transformer.

The oil level gauge shall be mounted in such a way that the oil level can be clearly seen from ground level.

A dust, vermin and weather proof terminal box shall be provided at the lower end of the current transformer for terminating the secondary windings. The box shall have a bolted cover plate complete with gaskets. The terminal box shall have terminal blocks, cable gland plate and cable glands with shrouds suitable for different sizes of PVC insulated control cables 650/1100V grade as per IEC:227 or IS:1554. The terminal blocks shall have covering of moulded insulation materials complete with brass studs, washers, nuts and lock nuts suitable for termination of 2X2.5 sqmm wires. The termination shall be made by crimping lugs or bare wire with insulating sleeves at ends.

The terminal box enclosure shall have protection as per class IP 55 as defined in IEC: 529 or IS: 13947.

#### **6.7 CT Junction Box/Console Box**

Each set of 3 current transformers for three phase shall be provided with a common junction box mounted on the circuit breaker supporting structure at a convenient position to accommodate the secondary wire of CT and other control cables of Purchaser. Separate terminals for testing the relays and instruments and short circuiting of each current transformer secondary wires shall be provided in it. The junction box enclosure shall have the same protection features as for the terminal box. It shall be provided with terminal blocks, gland plates and glands suitable for different sizes of cables. Facilities shall be provided for earthing the CT secondary wires in the junction box.

#### **6.8 Hollow porcelain insulators**

The insulators of the current transformers shall conform to latest edition of IS: 5621 and shall be subjected to and successfully pass the tests listed in this standard and in IEC: 233. The hollow porcelain insulators shall be brown glazed and shall meet the requirements indicated in this specification. The insulators shall be cemented with Portland cement to the flanges resulting in high mechanical, tensile and breaking strength.

#### **6.9 Insulation level**

The current transformers shall be designed to withstand impulse test voltages and power frequency test voltages as specified in this specification.

#### **6.10 Terminal connections**

The CTs shall be provided with bi-metallic solderless clamp and rigid type terminal connectors on the top tank for connection to the HV terminals. The other requirements shall be same as for the terminal connectors of the circuit breaker described in this specification. They shall be universal type suitable for both horizontal and vertical connections.

Two earthing terminals complete with necessary hardware shall be provided on each CT for connecting to earth continuity conductor to be provided. The earthing terminals shall be identified by means of appropriate symbol marked in a legible and indelible manner adjacent to the terminals. The terminals shall be adequately sized to meet the full earth fault current envisaged.

#### **Basic technical requirement**

#### **6.11**

Ratings: The CTs shall conform to the following ratings and other particulars of the circuit breakers:

## Technical Requirements

Sl. No	Description		Requirements
1	Rated voltage	:	12 KV
2	Insulation level	:	
a)	Impulse withstand voltage	:	75 KVP
b)	One minute power frequency with voltage on	:	
i)	Primary winding	:	28KV rms
ii)	Secondary winding	:	3KV rms
3	Frequency	:	50Hz
4	Rated continuous thermal current	:	120% of rated primary current
5	Short time thermal rating and its duration	:	25KA for 3 sec.
6	Transformation ratio of CTs		
	600-300-150/1-1 A		<b>Core-I      Core-II</b>
a)	Rated output		15VA      15VA
b)	Class of accuracy		0.5      5P
c)	Accuracy limit factor		-      20
d)	Purpose		Metering    Protection    Protection
e)	Maximum exciting current at $V_k/2$		30mA
7	Type	:	Single phase, outdoor, Dead tank, oil filled & hermetically sealed

### 6.12 Tests and inspection

The CTs shall be tested in accordance with the requirements of the type tests and routine tests as per the latest issues IEC: 185 or IS: 2705.

The tests to be conducted shall include:

#### 6.12.1 Type Tests:

- Lightning impulse voltage;
- Power frequency wet withstand voltage;
- Temperature rise;
- Short time current;

- Composite error;
- Accuracy test (for measuring core);
- Instrument security current (for measuring core);
- Current error and phase displacement (for protection core)

#### **6.12.2 Routine tests**

- Verification of terminal marking and polarity;
- Power frequency dry withstand test on primary windings;
- Power frequency dry withstand test on secondary windings;
- Power frequency dry withstand test between sections;
- Over voltage inter-turn test;
- Composite error;
- Turn ratio;
- Accuracy test (for measuring core);
- Current error and phase displacement (for protection core);
- Knee point voltage and magnetizing current test (for PS class);
- Secondary winding resistance (for PS class).
- Insulation Resistance Test.

## **PROTECTIVE RELAY & CONTROL PANEL**

**Indoor control panels** with protective relay and meter shall be provided by the supplier suitable for above breakers. The equipment shall have protection scheme with the following relays:

(i) Triple pole IDMTL type combined over current (2Nos) & Earth fault (1No) relay (Draw out type) preferably Non-communicable numerical relay.

Plug setting range of the over current and earth fault relays shall be 5% to 250%.

(ii) 3 elements auxiliary relay for transformer fault, trip for Buchholz, winding temperature & oil temperature.

(iii) Master trip relay for inter tripping.

(iv) Differential relay.

(v) One alarm bell scheme with bell (24V DC).

N.B:- The relays should be Areva, Easun Reyrolle, ABB or of any reputed make (subject to approval during technical evaluation)

### **9. METERS:**

The following meters shall be provided.

i) Ammeter: - 1 No. , 0-300-600 A/ 1 Amp Preferable Make- IMP/ AE (Dial type).

ii) Volt meter: - 1 No., 0- 15 KV (size : 144mm x 144mm), make IMP/AE (Dial type).

iii) Ammeter selector switch- 1 No. Make – Kaycee or any other reputed make.

iv) Volt meter selector switch- 1No. Make- Kaycee or any other reputed make.

v) 40 watt lamp with switch- 1 No.

vi) Plug & Socket- 1 No.

vii) Fuses & Links- 1 No.

viii) Test terminal Blocks- Test terminal Block need be provided for testing relays & breakers.

ix) Indication Lamp- Red- Breaker „ON“

(24V DC LED type) Green Breaker „OFF“

Amber- Breaker “AUTO TRIP“

Blue- Spring charge indication.

White-Healthy Trip illuminated push bottom switch

### **10. OTHER EQUIPMENTS**

#### **10.1 In Door Control- Relay Panel**

##### **10.1.1 1. General**

The electrical controls, relays, instruments, meters, annunciation scheme shall be provided in a sheet steel enclosure conforming to IEC: 298 or IS: 3427 mounted on support base on the floor. The panel shall be free standing, dust, moisture and rodent and vermin proof suitable for indoor installation. The panel shall have a high degree of protection for indoor installation with relevant standard.

Each panel shall comprise of rigid welded structure frame enclosed completely by metal sheet of thickness not less than **2.5mm**. The sheets shall be cold rolled with smooth finish leveled and free from flaws. The structural frame and all load bearing members of the enclosure shall have minimum thickness of 2.5mm.

The control & relay panel board shall consist of panel, vertical independent, structure mounted with equipment mounted & wiring access on front and having double door protection (inside door to be glass covered) to prevent water entry inside the panel. Doors shall have handles with built in locking facility. All door panels and removable covers shall be gasketed all round with neoprene bonded gasket. Vewntilating louvers shall be provided to limit the temperature rise as provided in IEC: 694 and 298 or IS: 12729 and 3427. They shall be provided with filters encased in fine wire screens for non-ferrous metal or stainless steel unaffected by moisture and rain water. A 230V AC heater with auto temperature control shall be provided in the cabinet to prevent moisture condensation.

The housing shall be surface treated and painted in accordance with the clause on Surface Treatment of this specification.

#### **10.1.2 Panel wiring and accessories.**

##### **10.1.3 Wiring**

Each panel shall be supplied with all internal wiring complete.

Panel wiring shall be suitably bunched and clamped for neat appearance. The conductors used for wiring purpose shall be PVC insulated 650/1100 volt grade semi-flexible heat resistant, flame retardant and vermin proof electrolytic copper cable conforming to IEC:227, 502 or IS:1554. The wiring shall be securely supported and taken though PVC troughs. Each wire shall be continuous from end to end without any joint in between. All panel wiring shall be capable of withstanding a voltage of 2KV AC 50Hz for one minute.

Cable and wire for connections within the switchgear and between the switchgear and terminal blocks shall have a minimum temperature rating of 90 degree Celsius. The size of the conductors for panel wiring shall be not less than 2.5mm<sup>2</sup>. For CT secondary wiring, two such wires shall be used in parallel.

##### **10.1.4 Panel wiring protection**

The panels shall be equipped with links and HRC cartridge fuses conforming to IEC:269 or IS:13703 in 650 Volt grade phenolic moulded fuse holder consisting of fuse carrier and base or miniature circuit breakers conforming to IEC:947-2 or IS:13947-2 at appropriate locations. The carriers and bases shall be made of high grade flame retardant and non hygroscopic phenolic moulded material with hard glass surface. Each fuse or MCB shall be identified with engraved plastic label.

In general, fuses and MCBs shall be limited to the minimum required for safety. The protection scheme shall include fuses for VT secondary circuits and DC supply to each panel and fuses for MCB for spring charging motor and incoming AC supply.

#### **10.1.5 Terminal blocks**

Terminal blocks of brass studs rated for 10 amps continuous current, 650 volt DC grade covered by moulded insulating materials with adequate electrical clearances shall be provided for terminating the panel wiring and outgoing connections. The termination shall be made by crimping lugs or bare conductor with insulating sleeves at ends. The arrangement can be horizontal or vertical as per standard practice adopted by the manufacturer. All terminals must be numbered and wire termination provided with numbered ferrules for identification. All numbering and marking including those in wiring diagram shall follow the guidelines provided in IS: 11353. All circuit breaker auxiliary contacts including spare contacts shall be wired to the terminal blocks. Ten percent spare terminals shall be provided.

#### **10.1.6 Colour and numbering**

The wiring used for 230V AC supply for illumination lamp, panel heater and other devices shall be coloured red for phase wire and black for the neutral. The colour of wires connecting directly to Earth shall be black. All other panel wires shall be of one colour to be approved.

Engraved core identification plastic ferrules marked to correspond with the panel wiring diagram shall be fixed at both ends of each wire. Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected from the terminal block. Numbers 6 and 9, if used shall be under scored to enable differentiation.

#### **10.1.7 Circuit diagram**

A durable copy of the circuit wiring diagram shall be affixed to the inner side of the door of the switchgear compartment. Labels shall be provided inside the compartment to describe the functions of the various items of equipment.

The scope of the supply shall include the panel mounting base plate and all special equipment, bolts, nuts and washers necessary for making the supporting.

### **10.2 Supporting Structure**

The supply of the material shall be complete with mounting structures of mild steel sections conforming to IS: 226 or equivalent ISO. The supporting structure shall be designed and constructed to withstand the maximum combined effects of the circuit breaker dead weight, its maximum dynamic load and maximum effect of wind loading. The supporting structure shall be hot dip galvanized as per IS 2629.

### **10.3 CT mounting bracket**

The supporting structure shall be fitted with a bracket for supporting three oil filled 11 KV single phase current transformers as per enclosed GA drawing. The support bracket shall be provided opposite the circuit breaker poles and shall ensure adequate clearance between the breaker poles and the CTs as well as between the CTs. The CTs shall be supplied by the Supplier as per specification above and is included in the scope. The drawings of the structure with bracket shall be subject to Purchaser's approval before fabrication.

The CT mounting bracket shall be hot dip galvanized as per IS-2629.

### **10.4 Local control cabinet**

The operating mechanism, local controls and monitoring shall be provided in a metal clad control cabinet fitted to the same structure supporting the breaker and mounted at a convenient height for safe operation from ground level or from platform to be supplied under the contract.

The cabinet shall be made of minimum 2.5 mm sheet steel and shall be constructed as a dust, weather and vermin proof outdoor housing with protection of IP-54 class as defined in IEC:529 or IS:13947. It shall have single door and transparent windows for reading the circuit breaker ON or OFF position and spring charge position without opening the door. The door and any removable covers shall be gasketed all round with neoprene bonded gaskets. A ventilating louver shall be provided with fine wire non-ferrous metal or stainless steel screen and filter. A 230V AC heater with auto temperature control shall be provided in the cabinet to prevent moisture condensation and also a 230 volt lamp for internal illumination with door operated switch.

The local control cabinet shall be subjected to surface treatment and painting as per clause on surface treatment of this specification.

### **10.5 Panel wiring and accessories**

Panel wiring shall be suitably bunched and clamped for neat appearance. The conductor used for wiring purpose shall be PVC insulated 650 volt/ 1100V grade semi-flexible copper cable conforming to IEC: 227 or IS: 1554, heat resistant, flame, vermin and rodent proof. The wiring shall be securely supported and taken through PVC troughs. All panel wiring shall be capable of withstanding a voltage of 2KV AC 50Hz for 1 minute. Each wire shall be continuous from end to end without any joint in between.

The sizes of the control cable for wiring in the cabinet shall be not less than 2.5mm<sup>2</sup>. CT secondary wiring shall be though two such wires in parallel.

#### **10.5.1 Fuse protection**

The cabinet shall be equipped with links and HRC cartridge fuses in 650 volt grade fuse holders consisting of fuse carrier and base. The holders shall be made of high grade, flame retardant and non hygroscopic phenolic moulded material of dark brown colour with hard glass surface. Each fuse shall be identified with engraved plastic labels.

#### **10.5.2 Terminal blocks**

Terminal blocks rated for 10 amps continuous current, 650 volt grade covered by moulded insulating materials with adequate electrical clearances shall be provided for terminating the panel wiring and outgoing connections. The termination shall be made by crimping lugs or bare wire with insulating sleeves at ends. The arrangement can be horizontal or vertical as per standard practice adopted by the manufacturer. All terminals must be numbered and wire termination provided with numbered ferrule for identification. All numbering and marking include those in wiring diagram shall follow the guidelines provided in IS: 11353. Ten percent spare terminals shall be provided.

#### **10.5.3 Colours**

The wiring used for AC supply for illumination lamp and heater shall be differently coloured from control wiring so that these can be distinguished from each other. The colour of all earth wire shall be black.

#### **10.6 Circuit diagram**

A durable copy of the circuit wiring diagram shall be affixed to the inner side of the control cabinet. Labels shall be provided inside the cabinet to describe the functions of the various items of equipment.

#### **10.7 Cable Entry**

A removable gland plate shall be provided at the bottom of the cabinet for entry of Purchaser's control and auxiliary power cables in the cabinet. Required number of electroplated brass cable glands of appropriate sizes with shrouds shall be provided in consultation with the Purchaser in the gland plate for the control and power cables. Provision shall be made for earthing of the cable armours in the gland.

### **11 OPERATING MECHANISM**

#### **11.1 General**

The operating mechanism of the circuit breaker shall be motor wound spring charged type. It shall be electrically and mechanically trip free with anti pumping device (as per IEC: 694 definitions). All working parts in the mechanism shall be of corrosion resistant material. Self lubricating, wearing resistant bearings shall be provided in the mechanism.

The mechanism shall fully close the circuit breaker and sustain it in the closed position against the forces of the rated making current and shall fully open the circuit breaker without undue contact bounce at a speed commensurate with that shown by tests to be necessary to achieve the rated breaking capacity in accordance with IEC:56 or IS:13118. The mechanism shall be capable of being locked in either the open or closed position. The mechanism shall be capable of fully closing and opening again after the auto-reclose time interval specified as 0.3 second in this specification.

### **11.2 Spring mechanism**

The spring operating mechanism shall be with spring charging motor, opening and closing springs with limit switches and all accessories necessary for automatic charging. In normal operation, recharging of the operating springs shall commence immediately and automatically upon completion of the closing operation so that a complete sequence of closing and opening operation should be possible.

It shall be possible to hand charge the operating spring with the circuit breaker in either the open or closed position conveniently from the ground level. Closure whilst a spring charging operation is in progress shall be prevented and release of the springs shall not be possible until they are fully charged.

The state of charge of the operating springs shall be indicated by a mechanical device showing „**SPRING CHARGED**“ when closing spring is fully charged and operation is permissible and „**SPRING FREE**“ when closing spring is not fully charged and the operation is not possible. Provision shall be made for remote electrical indication of „Spring Charged“ and „Spring Free“ conditions.

The operating mechanism shall be such that the failure of any auxiliary spring shall not cause tripping or closing the circuit breaker but shall not prevent tripping against trip command.

Closing action of the circuit breaker shall charge the opening spring ready for tripping. From the close position with spring charged, one open-close-open operation shall be possible without recharging the spring.

### **11.3 Motor**

The motor for spring charging shall be single phase 230 Volt A. C motor. Continuous motor rating shall be at least ten percent above the maximum load demand of the driven equipment. It shall remain within its rated capacity at all operating points that will arise in service. It shall be protected by H.R.C cartridge fuses or MCB. The motor shall comply with IEC: 34 or IS: 996.

## **12. AUXILIARY POWER SUPPLY**

The operating mechanism shall be suitable to operate with the following auxiliary power supplies.

- a) 230V, 50Hz Single phase A.C- For spring charging motor
- b) DC supply 24 Volts- For close and open coils, indication & Alarm

(Power pack input supply: 230V & 110V AC and Output:24V DC)

The DC supply shall be from a Power Pack. The Input to Power Pack is 110V from PT and 230V from main supply. The power pack should be capable for minimum 3 Trippings even if input to power pack is failed.

The mechanism shall be designed to operate satisfactorily despite fluctuations of auxiliary power supplies as under:

AC supply:	Voltage	From 115% to 85% of normal voltage
	Frequency	From 105% to 95% of normal frequency
	Combined voltage and frequency variation	From 115% to 85% of normal
DC supply:	Voltage	From 120% to 70% of normal voltage

### **13. INTERLOCKS**

The circuit breaker shall be capable of being mechanically and electrically interlocked with the associated line isolator so that the isolator cannot be operated with the breaker in the closed position.

All doors or shutters which give access to live parts shall be interlocked in such a way that these cannot be opened unless the circuit breaker is in the open position.

Other interlocks shall be provided as deemed necessary for safety.

### **15. TERMINAL CONNECTOR**

Suitable terminal connectors of bi-metallic type suitable for both horizontal and vertical connection shall be provided on the terminal pad both on the incoming and the outgoing side for connection of jumpers of ACSR or AAAC conductor. The size of the conductor may vary between 50mm<sup>2</sup> and 232mm<sup>2</sup> depending upon the location of the circuit breaker. The terminal connection drawing and details are to be approved by the Purchaser before fabrication. The terminal connectors shall be bi-metallic type to avoid bi-metallic corrosion.

### **INSULATION AND CLEARANCE**

### **16.**

a) The insulation to ground, the insulation between open contacts and insulation between phases of the circuit breaker shall be capable of satisfactorily withstanding dielectric test voltages.

b) The minimum clearance in open air shall be as follows:

- Phase to phase spacing in switchyard i.e. interpole spacing for Breaker (min) - 320 mm
- Ground clearance from the lowest line terminal if both the terminals are not in same horizontal plane (min) - 2700mm

### **17. TEMPERATURE RISE**

The temperature rise and the maximum temperature of any part of the circuit breaker under continuous load condition and exposed in the direct rays of the sun shall not exceed the permissible limits as provided in Table V of IEC publication 694 or table 4 of IS:12729. These limits shall not be exceeded when corrected for the difference between the ambient temperature at site and the ambient temperature specified in the standard. The correction proposed shall be stated in the tender.

## **18. TESTS**

### **18.1 Type and routine tests**

The circuit breakers shall be subjected to routine and type tests in accordance with the standards listed in this specification including the following IEC and IS standards with the latest amendments:

- Circuit breaker IEC: 56 and IS:13118 and relevant other standards
- Porcelain insulator IEC: 233 and IS: 5621 and relevant other standards

The tests shall include but not limited to the following:

### **18.2 Short circuit tests**

The circuit breaker shall satisfactorily perform the out of phase and short circuit duties specified in IEC:56, IEC:17A(Sectt.) and IEC:17A/CD/474, IS-13118 and IS:13516.

The circuit breaker shall be capable of performing at least twenty five (25) open operations at the rated short circuit current before maintenance or inspection is required.

### **18.3 Capacitive current switching**

Capacitive switching tests shall be performed in accordance with IEC:56 or IS:13118 and IEC:17A/CD/474 at 1.3U preferably by direct test method or alternatively using synthetic method to IEC:427 or IS:13516. The test circuits shall simulate the most onerous site conditions.

### **18.4 Reactor Switching**

In addition to the capacitive current switching tests to IEC:56 or IS:13118 and IEC:17A/CD/474, the circuit breakers shall be tested for shunt reactor switching in accordance with IEC:1233, Examination of the interrupter after the tests shall not show any evidence of surface tracking or erosion of contacts.

### **18.5 Dielectric tests**

At zero gauge loss of vacuum inside the interrupter chamber, the open contacts shall withstand continuously, the rated phase to ground voltage and it shall be possible to break normal current in these conditions. During the dielectric type tests, no flashover external or internal shall be acceptable.

The circuit breakers shall be subjected to a power frequency AC voltage test for one minute in dry and wet conditions and there shall be no external flash over to earth.

### **18.6 Mechanical endurance**

In addition to the requirements of IEC:56, an extended mechanical endurance test is required to show that the circuit breaker is capable of at least 10,000 operations at no load in accordance with IEC:17A/474/CD. Between the specified test series in IEC: 17A/474/CD, some maintenance such as lubrication and mechanical adjustment is allowed and shall be performed in accordance with manufacturer's instructions. Change of contracts is not permitted.

### **18.7 Low current switching**

The circuit breakers shall produce very low over voltage (<2.0 pu) on all switching circuits inductive current including reactor switching to IEC-1233 and capacitive current switching to IEC:17A (Secretariat) 438 and IEC 17A/CD/474 the circuit breaker shall be re-ignition or re-strike free for all duties.

### **18.8 Duty requirement tests**

Apart from auto-reclosing and the other duties mentioned above, the breakers shall be able to perform the following duties for which type tests are to be conducted as per IEC:56 or IS:13118.

1. Breaking the steady and the transient magnetising current of the transformer.
2. Breaking 25% of rated fault current at twice the rated voltage as per IEC/IS.
3. Cable charging breaking current.
4. Back-to-back capacitor bank breaking current.
5. Single capacitor bank breaking current.
6. Capacitor bank in rush making current.

Test for the resistance of the main circuit shall also be conducted.

### **18.9 Temperature rise test**

Temperature rise test is to be conducted on the circuit breaker and the accessories in accordance with IEC:56 or IS:13118. The temperature rise shall be limited as per this specification.

## **19. PERFORMANCE REQUIREMENTS**

The supplier shall declare the circuit breaker opening and closing times at 120 percent, 100 percent and 70 per cent of the rated voltage of the opening and closing devices when measured at the terminals of the trip and closing coils. The minimum make break time at rated voltage and total break time of the CB shall be stated. The total break time must not exceed 60m. sec.

## **20. EARTHING**

All metal parts not intended for carrying current or not alive shall be connected to duplicate earthing system and suitable electroplated brass earthing terminals shall be provided on each circuit breaker in conformity with IEC:56 or IS:13118. Suitable identification mark for the earth terminals shall be provided adjacent to the terminal.

Earth continuity conductors shall be provided down to the ground level for earth connection to purchaser's earthing grid. It shall have sufficient cross sectional area to afford a low resistance path for the full fault current envisaged. Such conductor shall also be provided for the CTs up to the ground level.

The size of the earth continuity conductor shall be large enough to reduce the potential rise of

the metal frame of the breaker in the event of fault to minimum but in any case not more than 10V. The size of the conductor shall also be adequate to restrict the temperature rise without causing any damage to the earth connection in the case of fault. No riveted joints in the earth conducting path shall be permissible and only bolted joints of adequate size shall be provided with nuts, bolts and plain and spring washers. The surfaces to be jointed shall be perfectly flat without any unevenness to ensure that there is no contact resistance.

An earth bus bar of copper strip shall be provided inside the local control cabinet to which all earthing connections must be made. The earth bus bar shall be terminated into two electroplated brass earthing terminals of adequate size with nuts, bolts and washers for connecting to earth continuity conductor mentioned above.

**TECHINICAL DATA SCHEDULE FOR 11 KV OUTDOOR VACUUM CIRCUIT BREAKER**

SL NO	DESCRIPTION	As Per Specifications	UNITS	BIDDER'S OFFER
<b>1</b>	<b>GENERAL</b>			
	- Name of manufacture			
	- Manufacturer's type designation	Out-Door type		
	- Governing standards	IS : 13118, IEC-62271-100		
	- No. of poles of circuit breaker	3	no.	
	- No. of breaks per phase	1	no.	
	Type – Vacuum	Vacuum		
<b>2.</b>	<b>NOMINAL VOLTAGES</b>			
	- Rated voltage	11	KV	
	- Maximum(continuous)service rated voltage	12	KV	
<b>3.</b>	<b>RATED NORMAL CURRENT</b>			
	- Under normal condition	800	Amps	
	- Under site condition	800	Amps	
<b>4.</b>	<b>SHORT CIRCUIT PERFORMANCES</b>			
	- Rated short circuit breaking current:			
	- Symmetrical, rms	25	KA	
	- Asymmetrical including DC component	30	KA	
	- Rated short circuit making current; peak	62.5	KA	
	- Short time current withstand capability:			
	Peak value	62.5	KA	
	Rms value	25	KA	
	Duration	3	Sec	
<b>5</b>	<b>MAX. TEMP. RISE OVER AMBIENT OF 50<sup>0</sup>C</b>			
	- At normal continuous current	As Per IS	<sup>0</sup> C	
	- After performing the operating sequence		<sup>0</sup> C	
<b>6.</b>	<b>MAKE AND BREAK TIMES</b>			
	<b>Total break times</b>			
	- At 10% rupturing capacity	< 60	milli-sec	

	- At rated rupturing capacity	< 60	milli-sec	
	- Arcing time at rated breaking current	15 (Max)	milli-sec	
	- Make time from giving close command	< 60	milli-sec	
	- Minimum re-closing time at full rated interrupting Capacity from trip coil energisation	300	milli-sec	
	- Minimum dead time for 3 phase reclosing		milli-sec	
	- Circuit breaker opening time:			
	at 125% of rated voltage of opening device	< 60	milli-sec	
	at 100% of rated voltage of opening device	< 60	milli-sec	
	at 70% of rated voltage of opening device	< 60	milli-sec	
<b>7</b>	<b>RESTRIKING VOLTAGES FOR 100% RATED CAPACITY</b>			
	- Amplitude factor	62 KV		
	- Phase factor	3		
	- Natural frequency		Hz	
	- Rate of rise of recovery voltage		Kv/ $\mu$ s	
<b>8</b>	<b>RATED INSULATION LEVEL</b>			
	- Dry and wet power frequency withstand test voltage for one minute, rms:			
	- Between live terminals and grounded objects	28	KV	
	- Between terminals with breaker contacts open	28	KV	
	- 1.2/50 $\mu$ s full wave impulse withstand voltage +ve and - ve polarity, peak			
	- Between live terminals and grounded object	75	KVp	
	- Between terminals with breaker contacts open	75	KVp	
	- One minute power frequency voltage of auxiliary wiring	2	KV	
<b>9</b>	<b>OPERATING PERFORMANCE</b>			
	- Rated transient recovery voltage		KVp	
	- Rated cable charging breaking current	25	Amps.	

	- Rated single capacitor bank breaking current	400	Amps	
	- Rated back-to-back capacitor bank breaking current	400	Amps	
	- Rated capacitor bank in-rush making current	20	KA	
	- Rated small inductive breaking current	25	KA	
	- First pole-to-clear factor	1.5		
	- Rated operating sequence	O-0.3sec-CO-3min-CO		
	- Rated out-of-phase breaking current		KA	
	- Re-ignition and Re-strike free	Yes/No		
<b>10</b>	<b>NUMBER OF OPERATION POSSIBLE WITHOUT MAINTENANCE</b>			
	- at full rated interrupting current	>100	no.	
	- at 50% of rated interrupting current	>100	no	
	- at 100% of full load current	>10000	no	
	- at no load		no	
<b>11</b>	<b>MINIMUM CLRRARANCE IN AIR</b>			
	- Between phases	>150	mm	
	- Live parts to earth	>120	mm	
	- Live parts to ground level		mm	
<b>12</b>	<b>WEIGHTS AND DIMENSIONS</b>			
	Total weight of one complete breaker, including mounting structure		Kg	
	Mounting structure weight		Kg	
	Control cabinet weight		Kg	
	Dimensions: <b>Height</b>		mm	
	<b>Width,</b>		mm	
	<b>Depth</b>		mm	
	Drawings must be provided	Yes / No		
<b>13</b>	<b>HOLLOW INSULATOR HOUSING</b>			
	Type and make of insulators.			
	Power frequency withstand test voltage for one minute:			
	- Dry	28	KV	
	- Wet	28	KV	
	Flash over value			
	- Dry	75	KVp	
	- Wet	75	KVp	

	1.2/50 impulse voltage withstand capability			
	- positive polarity	75	KVp	
	- negative polarity	75	KVp	
	Creepage distance total	>300	mm	
	Creepage distance protected	>280	mm	
	Weight of assembled housing		Kg	
<b>14</b>	<b>SUPPORT INSULATOR</b>			
	Type and make of insulators			
	Power frequency withstand test voltage for one minute:			
	- Dry	28	KV	
	- Wet	28	KV	
	Flash over value			
	- Dry	75	KV	
	- Wet	75	KV	
	1.2/50 impulse voltage withstand capability			
	- positive polarity	75	KVp	
	- negative polarity	75	KVp	
	Creepage distance, total	>300	mm	
	Creepage distance, protected	>280	mm	
	Weight of assembled housing		Kg	
	Corona shield provided or not	Yes / No		
<b>15</b>	<b>CONTACTS</b>			
	- Type of main contacts			
	- Type of auxiliary contacts			
	- Material of auxiliary contacts	Copper		
	- Type of plating, if any	Silver		
	- Thickness of plating	20	Micron	
	- Contact pressure		gm/ sq.mm	
	No of auxiliary contacts provided:	6 NO + 6 NC		
	Those closed when breaker is closed	6	no	
	Those open when breaker is closed	6	no	
	Those adjustable		no	
<b>16</b>	<b>OPERATING MECHANISM</b>			
	Opening type	Shunt Trip		
	Closing type	Motor / Manual spring charge, Shunt/Magnetic actuator operation		
	Force applied by charged spring for closing		Kg / N	
	Time taken by motor for charging the spring from fully Discharged to fully charged position	<30	sec	

	Full sequence of operation	0-0.3sec-CO-3min-CO		
	Whether limit switches are provided with spring	Yes/No		
	Whether spring limit switches start stop the motor	Yes/No		
	Type and material of spring employed			
	Whether trip free	Yes/No		
	Whether anti pumping device provided	Yes		
<b>17</b>	<b>AUXILIARY AND CONTROL POWER SUPPLY</b>			
	- Normal auxiliary A.C supply voltage	230	Volts	
	- Voltage limits for proper operation			
	Maximum	115%	Volts	
	Minimum	85%	Volts	
	- Frequency limits for proper operation			
	Maximum	105%	Hz	
	Minimum	95%	Hz	
	- Normal control circuit voltage	24	Volts	
	- DC Voltage limits for proper operation			
	Maximum	120%	Volts	
	Maximum	70%	Volts	
	- Power required for trip coil	300	Watts	
	- Power required for closing coil	300	Watts	
<b>18</b>	<b>LOCAL CONTROL PANEL</b>			
	- Material			
	- Degree of protection			
	- Vermin proof provisions	Yes/No		
	- Weather proof provision	Yes/No		
	- Dust proof provision	Yes/No		
	- Ventilation provision	Yes/No		
	- Thickness of sheet materials used	3	mm	
	- Overall dimensions		mm	
	- Total weight		Kg	
	- Mounting arrangement			
<b>19</b>	<b>TERMINAL CONNECTOR</b>			
	- Material			
	- Bi-metallic or not	Yes/No		
	- Weight		Kg	
	- Dimensions		mm	
	- Size and type of conductor it can accommodate	100	sq mm	

	- Terminal pads silver plated or not	Yes/No		
	- Thickness of silver plating		microns	
<b>20</b>	<b>CORROSION PREVENTION SYSTEM FOR CIRCUIT BREAKER AND CONTROL CABINET</b>			
	- Surface preparation			
	- Rust inhibition			
	- Zinc thickness/paint thickness		Microns	
	- Treatment of fasteners			
<b>21</b>	<b>CORROSION PREVENTION SYSTEM FOR SUPPORT STRUCTURE</b>	<b>Hot Dip Galvanized</b>		
	Surface preparation			
	Rust inhibition			
	Zinc thickness			
	Treatment of fasteners.		Microns	
<b>22</b>	<b>VACUUM CIRCUIT BREAKER SEALING</b>			
	Degree of protection of circuit breaker pole enclosure (IEC 529, IS 13947).			
	Method of sealing the circuit breaker pole enclosure.			
<b>23</b>	<b>CURRENT TRANSFORMER</b>			
<b>1</b>	<b>Category A; 600-300-150 / 1-1A</b>			
	Make and type of transformer	Out type, 1 ph, Oil cooled, Dead Tank		
	Ratio	600-300-150/ 1-1 A		
	Core1. VA burden	15	VA	
	Accuracy class	0.5		
	Saturation factor			
	Instrument security factor	10		
	Accuracy limit factor			
	Core 2. VA burden	15	VA	
	Accuracy class	5P		
	Saturation factor			
	Accuracy limit factor	20		
	Knee point voltage (Vk)	> = 150	Volts	
	Magnetizing current at Vk/2	< 30 mA at 0.5 Vk	Milli Amps	
	Secondary resistance R <sub>ct</sub>		Ohms	
	Short time current rating, time	25 KA for 3 sec	KA / Sec.	
	Impulse voltage withstand level	75	KV	

	Power frequency voltage withstand level			
	Primary winding	28	KV	
	Secondary winding	3	KV	
	Weight of CT complete		Kg	
<b>24</b>	<b><u>INSTRUMENTS &amp; METERS</u></b> <b><u>(Ammeter , Volt Meter &amp; Energy Meter)</u></b>			
<b>A.</b>	1. Type & make of Ammeter & voltmeter	Analogue type .AE		
	2. Size	144x144		
	3. Whether magnetically shielded or not	Y e		
	4. Limits or error in the effective range	± 2 %		
	5. Scale length	90		
	6. Whether Tropicalised			
	7. Short time overload rating	200 %		
	8. V A Burden.			
	i) Current coil		VA	
	ii) Potential coil		VA	
	9. Power consumption current & potential coil		Watt	
<b>B.</b>	<b>Energy Meter Type:</b>	(3 Ph ,4 wire with Alpha		
	Make	Secure meter/ L &		
<b>C.</b>	<b>BACK UP RELAYS</b>			
<b>1</b>	Type of relay	2 O/C +1 E/F, self actuated ,1 Amp, Aux. Volt-24 V DC/ Numerical & Non		
	Make	AREVA, ER, ABB		
<b>2</b>	Current coil rating	1	Amp	
<b>3</b>	Tap range	5% to 250 %		
<b>4</b>	V A Burden Highest tap & lowest tap	3		
<b>5</b>	Power consumption Highest tap & lowest tap		Watt	
<b>6</b>	Time of operation at maximum time dial setting at			
<b>7</b>	5 times tap setting current	1.6-	Sec	
<b>8</b>	10 times tap setting current	1	Sec	
<b>9</b>	Type of characteristic	IDM		
<b>10</b>	Whether draw out type or not	Y e		

<b>11</b>	Trip contact ratings Amps.	5 A continuous	Amp	
<b>12</b>	Whether seal in contacts provided or not	Yes/ No		
<b>13</b>	No. of contacts	2 NO+2 NC		
<b>14</b>	Flag/LED	Required		
<b>D.</b>	<b>Three element voltage operated Aux. Relay</b>			
	Type & make of the Relay	AREVA, ER, ABB		
	Voltage coil rating	24 V DC	Volts	
	No. of elements	3	No.	
	Mounting	Flush		
	Aux. Contact on each pole	1 NO + 1 NC		
	Flag	Required		
	Purpose	Trf protection		
<b>E.</b>	<b>High speed Tripping Relay</b>			
	Type & make of the Relay	AREVA, ER, ABB make		
	Voltage coil rating	24 V DC	Volts	
	Contact(Hand reset)	3 NO +1 NC		
	Flag	Required		
<b>F.</b>	<b>High speed Harmonic Restraint Differential Relay</b>			
	Type & make of the Relay	AREVA, ER, ABB make		
	Voltage coil rating	24 V DC	Volts	
	Aux. Contacts(Hand reset)	2 NO		
	Mounting	Flush		
	CT secondary	1 Amp.		
	Differential current setting	15%		
	Bias setting	15-30-40 %		
	Flag	Required		
<b>G.</b>	<b><u>POWER PACKS (2 X 12 V inbuilt Battery)</u></b>			
	1. Rated AC voltage.(Input 230 V AC or 110 V. AC ).	230 /110 Volt AC	Volt	
	2. Single phase or three phase.	Single phase		
	3. Capacity(VA)	300		
	4. Power factor			
	5. Type of transformer used, if any, to supply input to the rectifier			
	6. Transformation ratio			
	7. Type of rectification employed, full wave or half wave	Full wave		
	8. Type of rectifier connection	Bridge		
	9. Ripple factor			
	10. Type of filter employed			
	11. Ratings of capacitor			

	12. Time of retention of charge by capacitor			
	13. Value of DC constant.			
	14. Out put voltage(DC)	24 ± 15%	Volt	
	15. Capacity (Watt-sec)			
	16. No of closing & tripping taken by this pack.	>10		

**Signature of the Bidder with Seal**

